DOCUMENT RESUME

ED 081 225 EM 011 404

AUTHOR	Straus, David A.; And Others
TITLE	Tools for Change; A Basic Course in Problem-Solving.
INSTITUTION	Interaction Associates, Berkeley, Calif.
SPONS AGENCY	National Inst. of Mental Health (DHEW), Bethesda, Md.
PUB DATE	Sep 69
NOTE	104p.; See also EM 011 405 and EM 011 406
AVAILABLE FROM	Interaction Associates, Inc., 2637 Rose Street, Berkeley, Ca. 94708 ($3.00)
EDRS PRICE	MF-$0.65 HC Not Available from EDRS.
DESCRIPTORS	Course Descriptions; *Educational Games; Elementary Grades; *Games; Graduate Study; *Problem Solving; Secondary Grades
IDENTIFIERS	*Tools for Change

ABSTRACT

Tools for Change, a new course in problem-solving, consists of a series of units, each dealing with a subject area based on a set of heuristic processes or strategies. It assumes that: 1) there is an identifiable and useful set of heuristic processes in problem-solving;) a language of process will improve communication between problem-solvers; 3) educators can use heuristics to synthesize the curriculum; and 4) games are effective in teaching and learning about heuristics. Each unit of the course deals with a subject area based on a set of heiristic processes and each has three sections. Section I identifies strategies, using games as a medium. The second and third sections seek instances in other contexts and apply them in concrete situations. Initially, the course will be taught at the elementary, secondary, and graduate school levels to groups of about 15 students, for two 2-hour periods a week. Qualitative evaluation will be gathered from student feedback, protocol analysis, and observation; quantitative assessment will be deferred until later. A bibliography, glossary of heuristic terms, course outline, and list of games are appended to the report. (PB)

ED 081225

APR 21 1971

TOOLS FOR CHANGE

A Basic Course in Problem-Solving

Report

Interaction, Inc.

September 1969

DAVID A. STRAUS

R. CHRISTOPHER THORSEN

RUTH E. THORSEN

FILMED FROM BEST AVAILABLE COPY

EM 011 464

ED 081225

TOOLS FOR CHANGE

A Basic Course in Problem-Solving

DAVID A. STRAUS

R. CHRISTOPHER THORSEN

RUTH E. THORSEN

September 1969

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

This report was prepared with partial support provided by the National Institute of Mental Health under Grant #R01 MH 16285-01, Behavioral and Systems Approaches to Design.
Sim Van der Ryn, Principal Investigator.

Copyright: Interaction, Inc.

PERMISSION TO REPRODUCE THIS COPYRIGHTED MATERIAL BY MICROFICHE ONLY HAS BEEN GRANTED BY
Interaction Associates
TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE NATIONAL INSTITUTE OF EDUCATION. FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER.

PREFACE

In the following report we present Tools for Change, a basic course in problem-solving. The groundwork for this course was a research project on the theory and practice of problem-solving. (David A. Straus, Problem-Solving Notebook, Progress Report, Department of Architecture, Berkeley, June, 1969).

Tools for Change is based on the following premises:

1. That we have identified a set of basic heuristic processes that are involved in problem-solving.

2. That a common language of process will improve communication between problem-solvers.

3. That awareness of these heuristics and experience with them in different contexts will significantly increase productivity and flexibility in thinking.

4. That games are an effective context in which to initially discover the power of heuristics.

5. That, since heuristics are used in all subjects of our educational system, educators can use them as common denominators to synthesize curriculum.

6. That Tools for Change can be presented with success at any age level from elementary to graduate school with only minor adaptations in sophistication of theory and context.

7. That students should be involved as a creative resource in solving educational and community problems.

TABLE OF CONTENTS

		Page
Preface		i
Introduction		1
Importance of a Language of Process to the World in General		5
Importance of Process to Schools		7
How Do You Teach a Process?		11
Course Model		19
Implementation		27
Evaluation		31
Bibliography		35
Master List and a Short Glossary of Heuristics	Appendix I	1-11
Course Outline	Appendix II	1-32
Films, Games, and Problems	Appendix III	1-11
Goals of Interaction, Inc.	Appendix IV	1-2
Brief Resumes	Appendix V	1-2
Resource People	Appendix VI	1-2

INTRODUCTION

What can we give our children?

CHANGE... values, technology, youth - the whole world is changing at an ever-increasing rate. How do we prepare ourselves for a world of change? What can we teach our children that will be useful to them in a future we can not even predict? We must share with them the tools for change.

Process tools.

What are these tools? Clearly, they can not be only physical. Technology itself is changing too fast. These tools must be dynamic: actions, attitudes, plans. They are, in fact, processes: actions that make change, not the static product of change. If we are to prepare ourselves for change, we must identify these process tools and understand their power. In fact, they may be some of the few things of lasting value we can share in our educational system.

We must make some definitions.

We do not have a common language to talk about Tools for Change. The vocabulary exists, words to describe processes, but they have not been put together in a coherent way. We must, therefore, make some definitions in order to discuss the subject of this report.

Processes: Actions which make change.

To begin, we define a process as an action or series of actions that produce a certain kind of change. To add or subtract, to generalize or concretize - these are processes we use to change whatever we are dealing with. But actions alone are not enough to account for intelligent behavior. We must be able to react to our reactions, to evaluate them in order to adjust to their success or failure. Try reaching for something with your eyes closed, or picking something up when your hand is "asleep." We could not live without constantly adjusting. This action-reaction cycle is what has been called feedback. We make a move, instantly evaluate the effect of our action, and adjust our next action accordingly. Life can be seen as a constant trial-and-error procedure. Trial - because we are never sure that our actions will be successful, error - because our trials rarely produce exactly the change we expect, and so we make another trial.

Action-Reaction cycle: feedback and trial-and-error.

Heuristics: kinds of trials.

Processes that involve action and feedback, specific kinds of trials, we call heuristic processes or simply heuristics. We believe that we have organized most actions, specifically those involved in problem-solving, into a general set of processes. Therefore, at a certain conceptual level, there may be a limited number of heuristics in problem-solving. (See Appendix I.)

Problem: a conflict.

Problem-solving: conflict-resolving.

We define a problem as a situation someone perceives as having to be changed: a conflict between what exists and what should be. Problem-solving, therefore, is situation-changing or conflict-resolving. In its most general sense, problem-solving includes the actions involved in perceiving, analyzing, remembering, planning, alternative generating, evaluating, and synthesizing. That includes most moments of conscious living, since our whole organism is constantly changing and making change to meet a multitude of conflicts. We are successful problem-solvers inasmuch as we are able to intelligently select a heuristic process to meet each new situation. Obviously we are all reasonably good problem-solvers or we wouldn't be alive. Most of our trial-and-error living is based on gradually and subconsciously formulated patterns of response to deal with the kinds of typical problems we have met over and over again.

Problem-solver like a carpenter.

But what happens when we meet a problem we have never seen before? Habitual responses are not always good enough. It is just these kinds of critical situations, when we can go no further by repeating what we have done before, that awareness of the available tools for change becomes important. A good problem-solver can be likened to a good carpenter. The

carpenter has an array of tools before him. He knows the power and limitations of each. When he encounters a new problem he can look over his repertoire of tools and make intelligent choices as to which tools are more likely to do the job. In the same way a good problem-solver who encounters difficulties can step back and review how he has been approaching the problem and consciously select a new heuristic as a tool to attack it.

Limited process repertoires.

Each of us has a process repertoire, a number of heuristics that we have discovered and know how to use. However, for most of us, our process repertoires are overly limited simply because we have never been exposed to other ways of doing things, or we have had bad initial experiences. Our world is, in fact, divided into two process-biased camps: the scientific or what Dr. Jerome Bruner calls "right-handed" people, and the non-scientific, intuitive, or "left-handed" people. Our educational system seems to separate children into one of these two camps and thus further limits their process repertoires. Awareness of tools for change and experience with them in different contexts may lead to more flexible and ambidextrous thinking.

Awareness of process.

IMPORTANCE OF A LANGUAGE OF PROCESS TO THE WORLD IN GENERAL

Men must communicate processes.

People everywhere are being forced by the sheer magnitude of the problems they face into spanning professional boundaries in their efforts to coordinate action. They must communicate how they are approaching their aspect of a problem to others in different fields. They must agree on common processes. The cost of failure is too great to rely on intuition and blind trial-and-error procedures. Men in many fields are seeking a common language of process.

No common language.

The foundations for such a language have been in the making for years. The fields of cybernetics, information processing theory, and computer programming have been facing the problem of how to describe the characteristics of change. Fortran, an I.B.M. programming language, has almost become an international language. And yet Fortran and most of the other technical languages are too limited to serve as a common language of process for the average person.

Moreover, technology is about to produce another significant quantum jump in man's ability to deal with problems.

Augmentation systems.

This era is going to be characterized by interaction: man-machine as well as man-to-man. Interactive computer systems, known as augmentation systems, will instantaneously implement the time-consuming dirty work of the problem-solving cycle. Today, most of our working hours are spent implementing one trial idea only to be able to visualize its effects in order to evaluate it and make another trial. Tomorrow, with augmentation systems the situation will be reversed. Most of our time will be spent thinking, while the working out, the drawing up, the typing of our ideas will be performed by augmentation systems. Will we know how to use such powerful systems? Will we understand our own problem-solving processes well enough to be able to keep up and use effectively such extensions of our minds. Strangely, while technology may be producing the physical tools to meet the problems of tomorrow, the very presence of these tools demands a better understanding of our own mental process tools, our "on-board" tools for change.

Will we know how to use them?

IMPORTANCE OF PROCESS TO SCHOOLS

Students through their education should become aware of our tools for change. A language of process could serve as a common denominator by which students could relate the world of experience and content they encounter in different subjects. This may be the most powerful role that a set of basic heuristics could play: to relate and synthesize the variety of approaches and methods taught in courses that are often compartmentalized. For, in fact, a given heuristic is used in many if not all courses, but it is often disguised in highly specific contexts with particular sets of operations associated with it. For example, the heuristic of "working-in" is known in mathematics as the process of "setting boundaries to solution space" or later as "linear programming"; in graphic design as the act of "blocking-in" a design; in the game of Hangman as "figuring out" what letters are not in the word; and in curriculum scheduling as "eliminating" courses which meet at the same time. Children often know processes in terms of a specialized sequence of acts like "goes-into" or "putting-that-thing-over-there" and are unable to see that a method used in one context can be used equally as effectively in a totally different situation. By being encouraged to relate

Process Language: synthesizing curriculum.

many different experiences to a common set of conceptual processes students may be able to construct for themselves a more coherent picture of how various parts of their curriculum are related.

Relating methods.

A language of process might allow teachers and school administrators to coordinate curriculum programming and provide opportunities for joint ventures between departments using a particular process as a common denominator. Heuristics can provide the basis for more communication among students and teachers. Students can be encouraged to share how they found a solution with each other, if the initial importance of the right answer is de-emphasized. Most of our thinking is kept locked up in our heads because we have no established vocabulary for communicating these experiences. This situation tends to reinforce our belief that no one could think the way we do. Moreover, we are less likely to share how we think with someone else when we feel in competition with each other for approval and evaluation.

Stressing how more than what.

Because students are not given the language to verbalize their own thinking, teachers have difficulty in developing a dialogue about thought processes with them. Students are

Communicating experiences in thought.

convinced that the teacher must think "differently" and would never understand how they think. By establishing a language of process, communication about thought can be facilitated.

Students as creative resource.

Students have not yet been involved as a creative resource in solving educational and community problems. Almost half the country is under 25 years of age, and a large percentage of these people are in school. This is a powerful force, a fact that the students themselves are just beginning to realize. So far most of their coordinated energy has been focused on criticism and even destruction of the educational system. Give them the tools for change and let them attempt to solve their own educational problems, and we feel confident that the intensity of their involvement and the quality of their solutions, as well as their willingness to implement them, will be astounding and rewarding. Make it real for them, and they will, as a whole, act with maturity and with discretion.

Looking for processes.

Learning by looking at the world in terms of process can be fun. Almost every aspect of life can be seen as a product of some change. By asking ourselves how this change relates to other changes and what we can learn from it, meaning can be found everywhere. A process we use in solving a word problem

in mathematics can be related to a process involved in sending the astronauts to the moon. A way of seeing in design can be related to points of view of great men throughout the history of art. By discussing how we approach our own problems, each of us can become a resource, and "sharing" rather than "lecturing" becomes the norm.

'HOW DO YOU TEACH A PROCESS ?

The question of how to teach a process has not yet been definitely answered by educators. As we have said before, a process is a change from one state to another. It is hard to see change. Often it happens too fast to see as in the sequence of thoughts before recognition or too slow as in the process of the development of an idea. A process can only be seen in context where it can be identified by its products or by-products. The process of addition can be seen by observing what was before and what is after. The process of dreaming can be observed only after the fact by trying to remember the dreams, or by studying the brain waves of a dreamer. It is, so far, impossible to climb inside someone's mind to actually see thought happening. We wouldn't even know what to look for if we could.

Processes are seen in context.

To learn a process we must experience it. Our first experiences must be positive and non-threatening: perhaps they might even be fun. The relationship between process and attitude in life is very strong. Our process repertoires are strongly biased towards how we feel about ourselves and life in

Processes are learned in context:

general. Very rigorous, right-handed thinkers are often afraid of the contradictions and lack of apparent order of dream and imagination. Very loose, left-handed thinkers feel equally threatened by the clarity and logic of scientific thought: afraid that their artistic powers will be killed by rigor. Thus to share the beauty and creative potential of imagery with a right-handed thinker, we need a context that is far enough away from his own home ground as to be non-threatening. Sometimes we tend to be more daring the farther away from home we get. To teach a process we need first of all to find appropriate contexts.

must find appropriate ones.

The Covington, Crutchfield, Olton Project at the Center for Productive Thinking at Berkeley uses the mystery story as a context. In their programmed learning course in problem-solving, the only one we know of, they use comic strips of detective stories to involve fifth and sixth graders and then to ask them questions about how they would solve the mystery. The course has produced remarkable results. Programmed-learning has certain built-in limitations, however. There is no group experience and no communication about process between students. It is difficult to connect a particular strategy used in the course to other problem contexts related to an individual student.

Mysteries.

Exercises.

Dr. Sidney Parnes at Buffalo University, in the only other major course in problem-solving we know, uses exercises to train for problem-solving processes, especially those involved in alternative generation. We find this exercise approach rather dry and limited and believe there are other contexts that are more interesting and flexible.

Games as initial contexts: involve play.

We believe that games are one of the best contexts in which to initially experience a process. Play is one of the first heuristics that we learn as a child and, in fact, is critical to concept learning. Play is enjoyable and non-serious. We are much more likely to try something new if we make a game out of it. While winning is a strong motivational force in game-playing, losing doesn't really hurt. Because after all, it is only a game.

Games isolate heuristics...

A game is a good context in which to observe process because it can be easily controlled. The rules of a game are constraints that limit the number of processes that can be used, and therefore intense contact with a few heuristics is more easily experienced. For example, the game of Twenty Questions stresses the use of the heuristics of "questioning" and "working-in" and does not require the heuristic of "diagramming." The

rules of the game restrict feedback to "yes" and "no" statements and so the effectiveness of particular kinds of questioning can be easily tested.

by limiting variables.

As problem contexts, games are also limited in the sense that variables are fewer and clearer than in real life. For example, in Twenty Questions there is only one answer to be found and you know when you have found it. Success or failure can be more easily traced to a specific move while in the complexities of daily living it is harder to isolate cause-and-effect relationships.

A different use for games.

We must point out parenthetically that our use of games differs from most in that we are not using games primarily as a way of teaching content. We are not using games in the way of Abt Associates of Cambridge: as simulations of real life situations. That is another good use. We use games to demonstrate strategies at work and therefore are not concerned with realism of the context. We give the students real problems to introduce the element of reality.

Games are also powerful as what we call "set-backs." Our educational system has built into it many traditional sets

or conditioned responses that inhibit experiential learning. Teacher-facing-rows-of-neatly-aligned-desks presents a mental set of confrontation and one-way communication. When you have just beaten your professor at a game of Scrabble, he doesn't seem so imposing any more.

Games are set-breaks.

Games that involve groups encourage communication of strategies. If you break the groups into "observers" and "players" and then switch positions periodically, the player is forced to explain his strategy to his replacement if their position is going to continue its plan. In two-man games you ask one player who has a dominating lead over another to switch positions. Each player will then have to try to understand what the other was attempting to do, and strategies will be exchanged.

Games encourage communication.

By playing a series of different kinds of games as a team, students will begin to appreciate the value of having a variety of types of thinkers on one team. If you have only good "figure-outers" on your team, you won't be very successful in games of skill and fantasy. Hopefully each student will become aware of his own process repertoire and abilities and become curious about other ways of doing things, if only to become a better player.

Different games: different processes.

Games allow self-discovery.

Perhaps most importantly, games provide a context within which people can discover for themselves the basic tools for change. Once you are aware of the basic heuristics you can point out the use of most of them in a series of well-chosen games. The fact that you can show a student that he already uses a particular heuristic in some aspect of his own problem-solving may have strong psychological effects. You are not presenting him with something totally new. You are revealing and helping him develop a process that is already latent within him.

AND GAMES WORK !

The evidence from our workshops with teachers so far has shown that games work extremely well in the ways we have just mentioned. In one session with a large group of teachers and students using only simple games like Twenty Questions the group generated almost word for word many of the heuristics we have identified. They were intrigued with this new way of looking at what they had done and immediately began making connections with other problems for themselves.

But only having experience with a heuristic in a game context is not enough to fully understand its powers and limitations. Transfer must be encouraged by making connections

between the application of the heuristic in a game and applications in many other aspects of life. While we know of no scientific proof, we believe that transfer should be enhanced by having a semantic label attached to the general concept of a heuristic, reinforced by many applications in different contexts. We do not know how we locate a process when we are searching for a new strategy in problem-solving, but there is strong indication of semantic coding in other kinds of information. We believe that a person will be more readily able to recall a particular heuristic if he has previously labeled it with a simple active verb and had experience with this process in many different problem contexts.

Transfer: labelling and different applications.

We also believe that understanding heuristics will be aided by seeing them in a context of what we call a working model of mental processes. We call it a "working" model because it includes only those facts about the mind which are helpful to know in order to understand your own difficulties in problem-solving. For instance, the power of listing items can be understood when you realize that you can only hold roughly seven plus-or-minus two pieces of information in short-term memory. It is helpful to know that seeing is a constructive act: that you build up an image. Learning to see is learning

Seeing heuristics in a larger context.

how to construct different kinds of images. Therefore, by presenting from time to time facts about mental processes from a working model, we will satisfy students' natural curiosity about themselves and help them to see the processes they are learning about in a larger context.

COURSE MODEL

To exemplify the application of our educational theories we offer the following description of a course model. In addition to the basic structure of our model we include vignettes to give the reader a closer look into the attitudes and techniques we consider central to our program.

Tools for Change may be presented as a series of units each of which deals with a particular subject area based on a set of heuristic processes or strategies. (e.g., Unit I Planning and Prediction: Plan-Predict, Assume-Question, Diagram-Chart.) The nature of the course subject matter is cumulative rather than subordinative. Thus the order in which units are presented varies depending on course focus, grade level, class size, and time and materials available. The internal structure of the unit will remain relatively constant throughout the course. Each unit will be broken down into three sections, each section having a different focus on the subject. It is most probable that these unit sections will relate directly to three two-hour sessions taught on separate days, although they could be expanded to cover more than one day each. A detailed description of each unit by sections is given in Appendix II of this report.

Unit: Subject Area and Related Strategies.

Section I - Discovering Unit Processes

Each section alternates between experience and discussion of experience. Geared to give the participant a positive look at each new subject area, Section I is centered on gaming. With each unit a set of games, puzzles and/or problems is chosen for inquiry into and discovery of a particular set of strategies. The spirit of this gaming will be based on play rather than winning. To insure this emphasis games might be played in small groups: half "players," half "observers." The facilitator* could then ask participants to exchange roles at mid-game or request that each player verbalize the reason for his move, giving the group an idea of the strategies involved. As gaming progresses intermittent discussions will encourage the emergence of process awareness in each participant. Special focus will be given to the power and limitations of each strategy in a variety of problem situations. Finally, in preparation for the next section participants will be asked to consider their own relationship to the new strategies and to seek out experience with them in home and school life.

Discovering Strategies in games.

*"Facilitator" is a word coined by Carl Rogers referring to a person who "facilitates" group interaction and problem-solving.

Section I - Vignette

Picture a classroom in an elementary school. The desks are arranged in small groups around the edge of the room leaving a space in the center. Within this central area lies a large throw-rug with pillows scattered on it. On the walls are a few "Strategy Sheets," sheets of newsprint where definitions and uses for each new strategy are recorded. On the blackboard are written the following words: "Introduction to Tools for Change." A mixed group of middle schoolers, teachers, and facilitators are seated at the desks about the room. It is early in the session, and the participants are grouped around different games. David, a facilitator, now asks the groups to stop play, move to the center of the room, and focus on the blackboard. This signals a discussion period.

David asks the group to think of strategies they have used in their games. Ruth, another facilitator, begins writing the ideas on the board as they are called out. The list grows quickly: trial and error, changing, questioning, organizing, messing around, guessing, and so on. The group is generating in its own words the basis of a process language. As David encourages the group in its work, Chris, the third facilitator, moves across the room. Two boys have wrestled each other off the rug and are beginning to disturb the group with their giggling. He settles them with a slight admonition as the group discussion continues. Soon the participants are instructed to return to small group gaming with designated "players" and "observers." The observers will be looking out for the use of the strategies listed on the board.

Once the groups are at work again, the facilitators begin moving between them, discussing strategies. Before long, however, a rubber band sails across the room, and the two boys are giggling louder than before. Chris approaches them again, and this time he gives them some special instructions. With ten rubber bands, four pencils, and a handful of paper clips, they must try to communicate to the class a strategy from the list on the board. Finally, they seem intrigued, and they are off to the cabinet for the materials. David now asks players to switch roles in mid-game. In order to do so, each player will have to share his game strategy with his replacement.

Section II - Looking for Unit Processes Everywhere

The initial common experience for this section will vary from a set of short films or slides to an occasional field trip. These experiences will be designed to demonstrate the ways in which the unit strategies are used in major fields of endeavor. (e.g., industry, government, the arts, etc.) Afterward, the participants will examine these experiences and make connections with other uses of the strategies they discovered in home and school life. They will be asked to trace the use of a process throughout their curriculum, being encouraged to go beyond the most obvious contexts. At the end of the discussion, an attempt will be made to generate potentially new uses for the unit processes. In the last part of Section II participants will turn again to games, ending the session with the selection and brief discussion of the problem for Problem Day.

Making Connections.

Section II - Vignette

Let's return to the elementary school for another look into the classroom. It is the same except there are more strategy sheets hanging on the walls, and the old ones are nearly filled with notation. On the blackboard this time are the words "Unit I: Planning and Prediction; Unit Strategies: Plan-Predict, Question-Assume, Diagram-Chart." The participants are arranged in three groups with a facilitator leading a discussion in each. On the rug Ruth's group has spread out some large sheets of paper. Members are listing ways in which the strategies might be used in different classes. One of the teachers and two of the students are discussing the importance of planning ahead when writing a story and noting their ideas on the appropriate sheet. Others of the group move from one sheet to another talking and writing. Across the room, the members of David's groups are searching in newspapers for articles in which facts are assumed without question.

Later Chris asks everyone to re-focus for a gaming session. Half of the class is to work with David on word problems and mystery puzzles while the other half of the class will return to playing the games which originally introduced the unit strategies. This time, however, before each new step the participant who is about to move has to predict what the effects of his actions will be. As the games are being set up and play begun, Chris is approached by a boy and a girl who want to play Chess. He agrees if they will make an effort to identify and record the unit strategies in the game. We leave the class as Ruth is pinning up a diagram of a heuristic drawn by one of the teachers during a group discussion.

Section III - Problem Day

Section III is designed to give the participants in Tools for Change a chance to apply the strategies they have learned in a real problem context. Any problem used on Problem Day must have been selected by the participants themselves and considered important to solve. Some individuals who could conceivably implement solutions to the problem must have been identified. They might be the school administrators, teachers, community officials, or the students themselves. If possible, these people should have been notified ahead of time so that they could contribute relevant information and, hopefully, become interested in the proceedings.

In Problem Day sessions involvement is more important than observation, and the quality of solutions now becomes the main concern. Participants will evaluate themselves on the basis of their personal contributions. Participation may not be necessarily in the form of ideas, for excitement and joy might be equally important in sustaining optimum momentum in such a problem-solving session. Solutions generated during Problem Day will be displayed on large sheets. Later these ideas will be organized and either presented to the official involved or implemented by the students themselves.

Section III - Vignette

Our final look into the classroom finds a few of the course participants conversing in a group on the rug. Everyone else is grouped in front of the blackboard on which is written:

Problem - How to Share Tools for Change with the Whole School?

What to Share?
Games/Time/Strategies
Problem-Solving Methods
Problems and Solutions
Film/People/Tape

How to Share?
Games...Booths/Tables/Teach-in
Strategies...

The tape recorder is running, and the class, well into the problem, is thinking up ways to share some of the course games. The more difficult problem of how to share strategies has been given to five people in a smaller group. A girl has been chosen as its facilitator, and a teacher is keeping notes. The other members include Chris and two boys. A few of the strategy sheets scattered on the floor before them are the focus of their conversation. One of the boys thinks that the sheets themselves would be good communicators. The teacher disagrees, but before she may criticize she has to say what she likes about the idea. She comments that the idea is a good one but that the sheets are too messy and illegible for someone from outside the class to understand. The girl suggests that they recopy the sheets, and all agree.

Meanwhile Ruth has noticed that a little girl in the large group seems bored by its proceedings, and she moves over to talk with her. After a brief interchange, Ruth finds an answer to the boredom with a camera, and the girl begins a photographic record of the session.

Before leaving this class completely, let's take a look at how they implemented their solution once they had reached it. A week later, back at our elementary school, we see this sign -

Got A Problem? Solve It!

Noon Workshop
All Purpose Room 105

And on entering the room during the noon hour we experience the following: A mixture of students, teachers, and parents are seen milling from one area to another. At the far end of the room we encounter the "gaming tables," a large square of long tables displaying all the games and puzzles used in the course. In the center of the square some course participants are explaining the rules and basic strategies of each game and how they are involved in problem-solving. Onlookers are encouraged to sit down and play, and many do. Moving among the people are a few teachers wearing colorful sandwich boards. On approaching them we are told that the boards are, in fact, "strategy sheets," and their function in the course is then explained. The next concentration of curious observers surrounds a single table where a few of the course participants are seated. They are demonstrating problem-solving techniques by accepting fun problems from those watching and then "solving" them. The last group of tables is arranged with graphic displays of all the problems that have been tackled so far in the course. Finally, all visitors are asked by a participant to evaluate the workshop by recording their comments into a tape recorder.

IMPLEMENTATION

We intend to present Tools for Change at three different levels over the next year and a half: elementary (5-6 grades), secondary (11-12 grades), and graduate (First Year Architecture). Because the course deals with processes that are basic to problem-solving of all ages, we believe that Tools for Change can be given successfully on all three levels with only minor adaptations in sophistication of content and theory. Not only do the principal investigators have experience at each of these educational levels, but we believe that this multi-level approach will produce valuable insights into the relevance and effectiveness of the course, otherwise unattainable. While it is our belief that a course in problem-solving should be presented several times during a student's education, we hope to discover at which age level, if any, the learning and transfer of heuristic use is the greatest. The constraints of having to be simple enough to make sense to a ten year-old and experienced enough to run with the graduate student will provide a healthy environment for the development of the course. Moreover, we hope to be able to make use of the potential for interaction between these age levels by having older students

A multi-level approach.

occasionally help with the instruction of younger students.

Tools for Change, to be most effective, should be offered twice a week for two-hour periods since it is important to keep continuity between classes. In order to make use of the experiential methods employed, two hours are needed to allow for a common experience and follow-up discussion. One hour would be extremely tight. The classes ideally should be balanced between male and female since each sex tends to have basic process biases that can usefully interact. At least one teacher should participate as member of the class, and two or three would be even better. The class should be between ten and fifteen in number to remain manageable and still allow for further division into two and five person groups. We would like teachers present for several reasons: to open up roads of communication through group participation, to have experience with the language and material of the course, to be of assistance in evaluating its success, and ultimately to be experienced enough to teach the course themselves.

Mixed class: two hours, twice weekly.

So that the introduction of Tools for Change to a particular school's community can be as smooth as possible, we would like to run a half-day or full-day workshop before classes begin

with the teachers whose students will be participating in the course. In these workshops we will present the basic theory and methods of the course, demonstrate some of the experiential material, and attempt to coordinate the organization of the units of the course with other subjects that the students will be studying. In this way channels of communication will be opened to the faculty as a whole and misunderstanding will be avoided.

Workshops with teachers...

In the same spirit, we would like to make an evening's presentation available to interested parents early during the introduction of the course. We realize that students will share only certain aspects of Tools for Change with parents, probably the games and films, and we would like to demonstrate how these contexts are used.

and parents.

Tools for Change is not dependent on any specific teaching materials or problem context. The heuristics involved can be demonstrated in almost any context. However, we feel that we should make use of some games and films that are available in the Bay Area. It will be more effective to use recording equipment like tape recorders, Polaroid cameras, and video tape machines. We stress that no single piece of equipment or

Many contexts are possible.

resource material is indispensible, but that some use of material in the categories of games, films, and recording equipment will increase the effectiveness of the course. We have included in Appendix III a list of materials available in the Bay Area.

The three principal investigators, as members of Interaction, Inc., are presently seeking a grant to assist in further development and implementation of Tools for Change. Under this grant we propose to write a book on problem-solving processes and to make specifications of a packaged version of Tools for Change including visual aids, games, materials, and teachers' manuals. We also intend to employ the on-line computer system of the Augmented Human Intellect Research Center at Stanford Research Institute. With the aid of a remote terminal we will use the system in the composition of the book and in the preparation of a data bank of resource people and programs we encounter in our research.

We are seeking a grant.

EVALUATION

We are interested in a definitive evaluation of Tools for Change, as will be the school systems with which we work. Unfortunately, no reliable quantitative tests of heuristic use in problem-solving has yet been developed. There are no measurement standards for creative problem-solving. Dr. J. P. Guilford has developed tests by factor analysis for what he calls "primary intellectual abilities." It may be possible to correlate his tests to applications of specific heuristics. In the fifth and sixth grades, we have the results of the Covington, Crutchfield, and Olton Project with which to compare. There are two quantitative approaches we will pursue.

No reliable quantitative tests...

While there are no quantitative tests immediately available, there are several ways we can get meaningful qualitative measurements of the success of Tools for Change. Although we intend to seek expert advice in measurement techniques, we present here a few possible procedures:

but several qualitative.

1. First of all, the qualitative evaluation of the teachers and students participating in the course should provide some indication of how successful we have been. Students will let us

Participant feedback.

know whether they are excited by the material and whether they are able to apply the basic heuristics in other areas of their lives. It is our prediction that they will immediately see the relevance of heuristic processes to success in school subjects. At the end of the class we will ask them to evaluate their own progress and comment on the course as a whole.

Protocol analysis.

2. The development of an individual's process repertoire should also be easily observed. The use of new strategy usually is evident from analysis of protocol in problem-solving. With the use of tape recordings and traces of thought on paper we should be able to tell when a student is approaching a problem in a new way. Since attitude and process are closely linked, the discovery and use of a new strategy should produce a change in attitude toward certain kinds of problems. For instance, the use of the heuristic combination of "listing and then ordering" ideas can be noticed when the student who always leaps to premature conclusions suddenly begins to record all the possibilities before committing himself.

Outside observers.

3. We hope to make use of outside observers who are experienced in judging change of attitude and achievement and who are not biased toward the course. There are usually several

competent people within a school system who could play this role. Far West Laboratories has also indicated interest in assisting us in this capacity.

Non-participant evaluation.

4. Transfer of problem-solving abilities to other courses may be judged by having non-participating teachers evaluate development of students who have been taking Tools for Change in comparison with their classmates and with past records of achievement. If a student has learned a few new strategies well enough to apply them in another context, the effect of these should be demonstrated over a period of time by the student's performance, particularly in self-disciplined projects.

Repetition.

5. By repeating Tools for Change at least two times in the same school on the same grade level we hope to be able to compensate for the initial enthusiasm for newness, the so-called "Hawthorne Effect." We expect that by the second or third semester we will be getting reasonably reliable evaluations.

Teaching assistants.

6. It is our hope that a course in problem-solving will be adopted as a permanent course in the curriculum of the schools with which we are involved. We hope to have teachers and/or students assisting us in teaching Tools for Change by the third

semester. If they can do so with ease after one semester of attending the course, we will know that our communication of the basic heuristics and their application has been successful.

While we intend to develop as many methods of evaluation as we can, we also believe that there are dangers in premature evaluation. Tools for Change is in its early stages of development, and there may be factors tangential to the purpose of the course with which we will have to deal. We suggest that the first semester be considered a pilot study and that serious evaluation be deferred until the second and third semesters.

Let's wait and see.

BIBLIOGRAPHY

Abt, Clark C., "Games for Learning," Occasional Paper No. 7, the Social Studies Curriculum Program, Educational Services Inc., Cambridge, 1966.

_____, "Games Pupils Play: Why Educational Games Win Converts," reprinted from Nation's Schools, McGraw-Hill, Inc., 1967.

Ackoff, Russell L., Scientific Method: Applied Research Decisions, John Wiley and Sons, New York, 1957.

Alexander, Christopher, Notes on the Synthesis of Form, Harvard University Press, Cambridge, 1964.

Alexander, Ishikawa, Silverstein, A Pattern Language Which Generates Multi-Service Centers, Center for Environmental Structure, Berkeley, California.

Alger, R. M., Hays, Carl V., Creative Synthesis in Design, Fundamentals in Engineering Design Series, Prentice Hall, Inc., Englewood Cliffs, N.J., 1963.

Alschuler, Alfred S., "Psychological Education," Journal of Humanistic Psychology, Spring, 1969.

Anderson, Richard C., Ausubel, David P., (eds.) Readings in the Psychology of Cognition, Holt, Rinehart and Winston, Inc., New York, 1966.

Archer, L. Bruce, Systematic Method for Designers, A series of articles in Design, April, 1963; June, 1963; August, 1963; November, 1963; January; 1964, May, 1964; August, 1964. Collected and reprinted as a brochure by Design, 1965.

Asimow, Morris, Introduction to Design, Fundamentals of Engineering Design Series, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1962.

Berne, Eric, M.D., Games People Play, Grove Press, Inc., New York, 1964.

Beveridge, W.I.B., The Art of Scientific Investigation, Vintage, Random House, New York.

Boulding, Kenneth, The Image, Ann Arbor Paperbacks, The University of Michigan Press, Ann Arbor, 1961.

Broadbent, Geoffrey 'Symposium...Design Methods in Architecture," in International Building News, Architectural Association Journal, February, 1968.

Bruner, Jerome S., The Process of Education, Vintage Books, New York, 1960.

_____, Goodnow, Jacqueline J., Austin, George A., A Study of Thinking, Science Editions, Inc., New York, 1967.

Churchman, C. West, Ackoff, R. L., Arnoff, L. L., Introduction to Operations Research, John Wiley and Sons, New York, 1957.

_____, Prediction and Optimal Decision, Prentice-Hall Inc., Englewood Cliffs, N. J., 1961.

Covington, Martin V., "An Experimental Program for Increasing Ingenuity in Visual Problem Solving," University of California, Berkeley.

Crutchfield, Richard S., Covington, Martin V., "Programmed Instruction and Creativity," University of California, Berkeley.

Design Quarterly, 66/67, "Design and the Computer," Walker Art Center, Minneapolis, 1966.

Dieges, Jon, and Schlossberg, Edwin, "Journal of Environmental Design," September, 1967, University of California, Berkeley.

Eastman, Charles M., "The Analysis of Intuitive Design Processes," mimeo., First Annual International Conference, Design Methods Group, June, 1968.

Eberhard, John P., "A Humanist Case for the Systems Approach," AIA Journal, July, 1968.

Eder, Ing. W. E., Gosling, W., Mechanical System Design, Pergamon Press, London, 1965.

Englebart, D. C., "Augmenting Human Intellect: A Conceptual Framework," Stanford Research Institute, Menlo Park, California, 1962.

Esherick, J., "Problems of the Design of a Design System," mimeo., Conference on Design Methods, September, 1962, Department of Aeronautics, Imperial College, London.

Evans, Benjamin H., "Architectural Programming - State of the Art," Education and Research Programs, American Institute of Architects, Oct., 1967.

Fabun, Don, "Communications," Kaiser Aluminum News, Oakland, California, 1965.

_____, "The Children of Change," Kaiser Aluminum News, Oakland, California May, 1969.

_____, The Dynamics of Change, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1968.

Feiganbaum, Edward A., Feldman, Julian (eds.), Computers and Thought, McGraw-Hill Book Co., 1963.

Flesch, Rudolf, The Art of Clear Thinking, Harper and Row, New Yor, 1951.

Gardner, Martin, Mathematics, Magic and Mystery, Dover Publications, Inc., New York, 1956.

Ghiselin, Brewster, The Creative Process, Mentor, 1952.

Goode, Harry, Hachol, Robert E., Systems Engineering, McGraw-Hill Book Co., New York Toronto, London, 1962.

Gordon, William J. J., "Making it Strange," Teachers Workbook Series, 4 Vols., Synetics, Inc., Boston.

_____, Synectics, Harper & Row, Publishers, New York, 1961.

Gregory, S. A. (ed.), The Design Method, Plenum Press, New York, Butterworths, London, 1966.

Griffith, Roger A., "A Pilot Project in 'On Location' Education," an inter-disciplinary project in success motivated education for non-motivated students from diverse backgrounds, Tamalpais High School District, Larkspur, California, Aptil, 1969.

Guilford, J. P., The Nature of Human Intelligence, McGraw-Hill, Inc., New York, 1967.

Haefele, John W., Creativity and Innovation, Reinhold Publishing Corp., New York, 1962.

Hall, Arthur D., A Methodology for Systems Engineers, Van Nostrand, 1962.

Hall, Dr. Edward T., "Language of Space," Washington School of Psychiatry Research employed in this paper was supported by grants from the National Institutes of Health and the Wenner-Gren Foundation for Anthropological Research.

Heath, Thomas F., "The Algorithmic Nature of the Architectural Design Problem," Presented at the First Annual International Conference of the Design Methods Group, Cambridge, June, 1968.

Hochberg, Julian E., Perception, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1964.

Holt, John, How Children Fail, A Delta Book, Dell Publishing Co., New York, 1964.

_____, How Children Learn, Pitman Publishing Corp., New York, 1967.

IBM Systems Journal, "Interactive Graphics in Data Processing," International Business Machines Corp., 1968.

Inland Steel Products Co., "Systemat," The Modular Systems Division, Inland Steel Products Co., Milwaukee.

James, William, Psychology: Briefer Course, Crowell-Collier Publishing Co., New York, 1962.

Jones, J. Chr., Thornley, J. C., (eds.), Conference on Design Methods, Oxford, Pergamon Press, 1963.

_____, "A Method of Systematic Design," Conference on Design Methods, University of California, College of Environmental Design, Dept. of Architecture.

_____, "The State-of-the-Art in Design Methods," mimeo., First Annual International Conference, Design Methods Group, June, 1968.

Kaufman, Gerald L., The Book of Modern Puzzles, Dover Publications, Inc., New York, 1954.

Kellog, Rhoda with O'Dell, Scott, The Psychology of Children's Art, A Psychology Today Book, Random House, New York, 1967.

Kelly, George A., "Humanistic Methods in Psychological Research," Journal of Humanistic Psychology, Spring, 1969.

Kleinmutz, Benjamin, (ed.), Problem Solving: Research, Method and Theory, John Wiley & Sons, New York, 1966.

Koestler, Arthur, The Act of Creation, The Macmillan Co., New York, 1964.

Kohl, Herbert, Thirty-six Children, A Signet Book, The New American Library, New York, 1967.

Leonard, George B., Education and Ecstasy, Delacorte Press, New York, 1968.

Lynch, Kevin, The Image of the City, M.I.T. Press, Cambridge, 1959.

MacKinnon, Donald W., "The Creativity of Architects," Institute of Personality Assessment and Research, University of California, Berkeley, 1962.

Mager, Robert F., Preparing Instructional Objectives, Fearon Publishers, Palo Alto, California, 1962.

_____, Developing Attitude Toward Learning, Fearon Publishers, Palo Alto, California, 1968.

Maltz, Maxwell, M.D., F.I.C.S., Creative Living for Today, Essandess Special Editions, New York, 1967.

Manheim, Marvin L., "Problem-Solving Processes in Planning and Design," Department of Civil Engineering, Massachusetts Institute of Technology, Cambridge, 1967.

McKellar, Peter, Imagination and Thinking, Basic Books, Inc., New York, 1957.

McPherson, J. H., Ph.D., The People, the Problems, and the Problem-Solving Methods, The Pendell Co., Midland, Michigan, 1967.

Miller, George A., Galander, Eugene, Pribram, Karl H., Plans and the Structure of Behavior, Holt, Rinehart and Winston, Inc., New York, 1960.

Mitchell, William J., New Skills for Designers, AASA Publications Ink, Carleton, Victoria, Australia, 1968.

Moffett, James A., Student Centered Language Arts Curriculum, Grades K-13: A Handbook for Teachers, Houghton Mifflin, Boston, 1968.

_____, "Drama: What is Happening," the use of Dramatic Art in the Teaching of English, National Conference of Teachers of English, Champaign, Illinois, 1967.

_____, McElheny, Keneth R., Points of View: An Anthology of Short Stories, Signet Classics, The New American Library, New York, 1966.

Mogar, Robert E., "Toward a Psychological Theory of Education," Journal of Humanistic Psychology, Spring, 1968.

Moore, Gary, "Creative Problem Solving in Architecture," Design Research Laboratory, College of Environmental Design, University of California, Berkeley, 1967.

Nadler, Gerald, Work Design, Irwin, London, 1963.

Neisser, Ulric, Cognitive Psychology, Meredith Publishing Co., New York, 1967.

Norris, K. W., "The Morphological Approach to Engineering Design," University of California, College of Environmental Design, Architecture Department, 1962. (Fall, Architecture 198 paper)

Olton, Robert M., Crutchfield, Richard S., "Developing Skills of Productive Thinking," University of California, Berkeley.

Osborn, Alex F., L.H.D., Applied Imagination, Charles Scribner's Sons, New York, 1963.

Parnes, Sidney J., Harding, Harold F., (eds.), A Source Book for Creative Thinking, Charles Scribner's Sons, New York, 1962.

Polya, G., How to Solve It, Doubleday Anchor Book, Doubleday & Co., New York, 1957.

Prince, George M., "How to be a Better Meeting Chairman," Harvard Business Review, January-February, 1969.

_____, "Draft of an Article from the Book Creative Leadership," Harvard Business Review, January-February, 1969.

_____, "The Practice of Creativity," Synectics, Inc., Cambridge, 1969.

Progressive Architecture, "Performance Design," August, 1957.

Rapoport, Anatol, Operational Philosophy, Science Editions, John Wiley & Sons, New York, 1965.

Rapport, Samuel, and Wright, Helen, Science: Method and Meaning, Washington Square Press, Inc., New York, 1964.

Reiser, Oliver, L., Cosmic Humanism, Schenkman Publishing Co., Cambridge, Massachusetts, 1966.

Rittel, Horst, "Architectural Design Methods," University of California, Berkeley, Department of Architecture, Spring, 1967, Architecture 130.

_____, "Kinematics and Dynamics of Processes," University of California, Berkeley, 1969.

Rusch, Charles, "Some Nearly Random Thoughts on the Visual Aspects of Design," Architecture 198 paper, University of California, Berkeley, March 1965.

Sanders, Norris M., Classroom Questions - What Kinds? Harper and Row, New York, 1966.

Sanoff, Henry, "Techniques of Evaluation for Designers," Design Research Laboratory, School of Design, North Carolina State University, Raleigh, 1968.

Smith, Paul, (ed.), Creativity, Hastings House, Publishers, New York, 1959.

Souder and Welden, "Computer Technology: New Tool for Planning," Directors of the Planning Group, Los Angeles Office of Bolt, Beranek and Newman, Inc., October, 1963.

Spolin, Viola, Improvisation for the Theater, Northwestern University Press, Evanston, Illinois, 1963.

Stanford Research Institute, "The Knowledgeable Analyst: An Approach to Structuring Man-Machine Systems," prepared for Air Force Office of Scientific Research, Office of Aerospace Research, U.S. Air Force, Stanford Research Institute, Menlo Park, California.

Starr, Martin Kenneth, Product Design and Decision Theory, "Fundamentals of Engineering Design Series," Prentice-Hall, Inc., Englewood Cliffs, N.J., 1963.

Student Publications of the School of Design, North Carolina State of the University of North Carolina, Volume 14.

Stulman, Julius, The World Institute, The Foundation for Integrated Education, Larchmont, N.Y., 1949.

_____, Evolving Mankind's Future, J. B. Lippincott Company, Philadelphia, 1967.

Stulman, Julius, "Fields Within Fields...Within Fields, The Methodology of the Creative Process: Climbing to Mankind's Solution," The World Institute, New York, 1968.

Taylor, Bailey, Branch, "Second National Conference on Architectural Psychology," sponsored by the Architectural Psychology Department, University of Utah, Salt Lake City, September, 1967.

Thorsen, R. Christopher, Gnarled Grasses, Rau Painu Press, Mill Valley, California, 1968.

Van der Ryn, Sim, "Design Directives - Student Housing, North Carolina School of the Arts," sponsored by Educational Facilities Laboratories, New York, June, 1966.

_____, "Notes on Method of Environmental Analysis," presented at AIA Research Conference, St. Louis, Mo., October, 1966.

_____, "Searching for a Science of Design - Problems and Puzzles," AIA Journal, January, 1966, reprint.

_____, "Three Proposals for Innovative Correctional Facilities," Department of Architecture, School of Criminology, University of California, Berkeley, June, 1967.

Voss, James F., Approaches to Thought, Charles E. Merrill Publishing Co., Columbus, Ohio, 1969.

Wehrli, Robert, "Open-Ended Problem Solving in Design," University of Utah, 1968.

Wheeler, C. Herbert, "Emerging Techniques of Architectural Programming," AIA, Department of Architectural Engineering, Pennsylvania State University, 1968.

APPENDIX I

MASTER LIST OF HEURISTICS

ABSTRACT-CONCRETIZE

ADAPT-SUBSTITUTE

ADD-SUBTRACT

ANALOGY-BRAINSTORM

ANALYZE-SYNTHESIZE

ASSUME-QUESTION

CHANGE-VARY

COMBINE-SEPARATE

COMPARE-RELATE

CONCENTRATE-DISPERSE

CONSCIOUS-UNCONSCIOUS

CYCLE-REPEAT

DEFINE-SYMBOLIZE

DIAGRAM-CHART

DISPLAY-ORGANIZE

DIVIDE-MULTIPLY

DREAM-IMAGINE

EVALUATE-DEFER

EXPERIENCE-RECALL

FORCE-RELAX

INCREASE-DECREASE

INCUBATE-PURGE

INTUIT-RATIONALIZE

INVOLVE-DETACH

LEARN-TEACH

LIST-CHECK

MOTIVATE-PRACTICE

OPTIMIZE-MINIMIZE

PLAN-PREDICT

RECORD-RETRIEVE

SEARCH-SELECT

SIMULATE-TEST

START-STOP

SYSTEMIZE-RANDOMIZE

TRANSFORM-MANIPULATE

VERBALIZE-VISUALIZE

WORK FORWARDS-WORK

WORK IN-WORK OUT

A SHORT GLOSSARY OF HEURISTICS

(The first definitions are taken from Webster's Seventh New Collegiate Dictionary)

ABSTRACT: To remove from the context of a specific reality, to reduce to basic principles, to put in the most general terms, to express as simply as possible, to widen the scope of the problem. Abstraction encourages an overview of the problem by thinking in terms of principles, processes, and general directions. Abstracting allows you to try new combinations of ideas without being tied down to particulars.
CONCRETIZE: To concretize is to make specific, to state in real terms, to illustrate by a particular set of conditions. Concretization is a good way to push your ideas to their limit, to test them by specifying all their parts or by demonstrating their feasibility through reference to existing situations.

ADAPT: To modify, to make fit the situation; to make a slight change for a new purpose. Adaptation is a principal strategy for generating a new solution by making relatively small changes in an existing idea or object to serve in a new situation.
SUBSTITUTE: To put in place of another, to exchange, to replace, to find something else that could do the job. Substitution resolves the problem by locating critical elements and replacing them by new processes or parts, often drawn from other fields. If that doesn't work, try something else in its place.

ADD: To join or unite, to build up, to grow by induction. Addition is the process of growth and development of a solution by exapnsion incrementally in terms of individual elements or sub-solutions. Additive growth is a common strategy for updating old solutions.
SUBTRACT: To take away by deducting, to reduce by elimination, to deduct, to simplify. Subtraction is a way of arriving at a solution by beginning with more than you need of material, processes, or ideas, and then progressively getting rid of what is not really essential, as in carving out a sculpture or editing a manuscript.

ANALOGY: Resemblance in some particulars between things otherwise unlike, correspondence in function between anatomical parts of different structure and origin, an example from a different field. To look for a problem analogous to yours and to examine its solutions for relevance is a good way to seek new ideas and to break away from fixations. In the synectics procedure three types of analogy are defined (direct, personal, and symbolic) and they are used to make an "excursion" away from the problem in order to come back at it from a new context through the process of "force-fitting".
BRAINSTORM: To fire out ideas without evaluation, to meet in a group for such purposes. Brainstorming is a process that can be used individually or in groups to generate a quantity of alternatives by spontaneously coming up with ideas, recording and deferring judgment of them, allowing each idea to stimulate new ones.

ANALYZE: To study or determine the nature and relationship of the parts, to separate into component parts, to break down and study in smaller problems. Analysis is the process of understanding a problem by breaking it down and studying its parts. Analysis can be considered an essential phase in problem-solving and as such, employs many of the other strategies.
SYNTHESIZE: To compose or combine parts or elements so as to form a whole, to resolve diverse conceptions into a coherent whole, to integrate. Synthesis is the process of building back up to a solution after the problem has been analyzed and alternatives generated. As such it is a phase of problem-solving that incorporates many of the other strategies.

ASSUME: To take for granted or true, to suppose, to accept conditionally in order to proceed another step. Assuming is a strategy for testing a potential solution to a problem by leaping over immediate uncertainties by ignoring them or fixing their values in order to investigate the consequences: an essential process in prediction and evaluation.
QUESTION: To doubt, to dispute, to inquire, to challenge concerning validity. Questioning all aspects of a problem including your own solutions is an essential strategy in problem-solving. Self-questioning helps sustain an internal dialogue that can keep you thinking flexibly.

CHANGE: To make different in some particular, to give a different position, course or direction to, to move to another, to replace with another. Changing is a strategy for using other strategies. Changing approach or media is a way of reacting to developments in problem-solving by shifting attack to become more effective and involves awareness and flexibility in your thinking.
VARY: To make a partial change in, to make different in some attribute or characteristic, to change a part in order to test its influence on the whole. Variation can be algorithmic, heuristic, or random. Variation induces change in order to investigate the relationship of factors in a problem: like systematically changing the dial on a lock to find the combination.

COMBINE: To bring into close relationship, to unite, to act together, to form a solution from several different parts. Combining and recombining are processes of simplification and synthesis: several different elements come together to produce totally new entities, as in chemistry.
SEPARATE: To make a distinction between, to divide, to sort, to break up into elements, to keep different things apart. Separating is a process of breaking apart a problem and dealing with different issues at different times. This clarifies the situation and concentrates your energy on a limited field. Separating can be used to remove elements from context in order to study them more closely.

COMPARE: To represent as similar, to examine the character or qualities of, to discover resemblances or differences, to put side by side. Comparing is a strategy for examining two or more things aspect by aspect, checking for similarities and differences in terms of attributes or functions. Comparison is used generally in order to make a selection or to analyze through contrast.
RELATE: To show or establish logical or causal connection between, to develop a mathematic or symbolic equation that expresses how two or more elements affect each other, to make relationshops. To relate is to find the force or theory that governs how two elements or variables behave with respect to each other. It is a critical strategy for understanding a problem and for developing an hypothesis or solution.

CONCENTRATE: To bring or direct toward a common center or objective, to gather into one body, mass, or force, to focus one's powers, efforts, or attentions. Concentrating in problem-solving is a process of collecting and directing energy, your own personal psychic energy and attention, on one aspect of the problem in order to make as much headway as possible.
DISPERSE: To cause to break up and go in different ways, to distribute more or less evenly throughout a medium, to scatter. In problem-solving dispersion is the process of letting your mind wander over the problem, not focusing on one aspect, stopping only to probe and not become entangled. Dispersion is a quick way to explore a problem and to balance periods of concentration.

CONSCIOUS: Perceiving, apprehending, or noticing with a degree of controlled thought or observation, marked by thought, will design, or perception, to be aware. To be conscious of your mental processes in problem-solving is an important ability to develop for any degree of mental self-control.
UNCONSCIOUS: Not knowing or perceiving, not aware, not consciously held or deliberately planned or carried out. The unconscious or subconscious thought processing is a complement to conscious thought and can, in fact, to some extent be purposefully directed. Strategies continue to operate subconsciously as in the spontaneous recall of a name you were looking for.

CYCLE: To pass through an interval of time during which a sequence of a recurring succession of events or phenomena is completed, to jump back and forth between several different strategies or points of view. Cycling is a process by which simultaneity or totality of view can be approximated by alternating between many different strategies. The problem-solving can be seen as a heuristic or feedback process. (Concept formation, implementation, and evaluation.)
REPEAT: To make do, or perform again, to try again, to keep attacking a problem from the same point of view. Repetition is important strategy for minimizing error and is basic to the process of learning in skill development. Many processes can only be successful after several repetitions.

DEFINE: To fix or mark the limits of, to determine the essential qualities or precise meaning of, to clearly express the problem. Defining is one of the most critical processes in problem-solving and can be considered a definite phase, incorporating many other strategies. As the definition sets certain limits to the range of possible solutions, redefining as a reiterative process can be used to widen or narrow the scope of the problem.
SYMBOLIZE: To represent, express, or identify by a symbol (something that stands for or suggests something else by reason of relationship, association, convention, or accidental resemblance). Symbolizing allows you to represent or define an element of a problem as abstractly as possible and then to manipulate it with respect to other elemtns, concentrating only on relationships.

DIAGRAM: To explain in simple graphic language, to describe relationships in terms of graphic symbols, to abstract graphically. Diagramming is the most fundamental way of recording ideas visually in two or three dimensions. It uses a symbolic and non-representational language to graphically express concepts in terms of relationships, sequences, and simplified features.
CHART: To represent the relationships between pieces of alphanumeric information graphically, to present sequences of events in time diagrammatically. Charging is really a special case of diagramming, specifically as a method for planning and scheduling sequences of events and activities by describing their relationships in graphic terms and then making projections concerning estimated real time, costs, etc.

DISPLAY: To spread before the view, to make visible, to present graphically. Displaying is one of the most powerful conceptual strategies related to perception and problem-solving. Graphic display relieves the short-term memory function from the human brain and allow information to be "remembered" simply by visually scanning, and its information density can be high because it does not need to be read in a particular sequence.
ORGANIZE: To arrange or form into a coherent unity or functioning whole, to make a pattern, to arrange elements into a whole of interdependent parts, to structure, to order. Organizing is the process of reducing large quantities of complex information into structures that we can handle and remember, often hierarchical in nature. To display and then to organize visually is one of the most powerful strategies in problem-solving.

DIVIDE: To separate into two or more parts, areas, or groups, to distribute, apportion, or allocate, to mathematically divide. Dividing in problem-solving is the process of allocating some precious resource like time, energy, or space in some proportion to some scale of values. It is an important strategy in planning and scheduling.
MULTIPLY: To increase in number greatly or in multiples, to augment, to propagate, to mathematically multiply. In problem-solving we define multiplying as the process of augmenting whatever you have in the way of product or process by increasing its effectiveness through making it larger or more powerful. Man's power is augmented or multiplied through his technological artifacts.

DREAM: To have vivid thoughts, images, or emotions during sleep, to observe subconscious mentation during periods of lack of conscious intervention. Dreams can provide valuable understanding of how a problem is being treated subconsciously and what are your feelings and motivations toward it, for it is only during sleep that your consciousness is turned off. Dream thought can be a source of rich images, and the period of dreaming just before complete sleep, or hypogogic dreaming, can actually be induced and can provide great insights into aspects of a problem.

IMAGINE: To form a mental picture of (something not present), to form mental images, to mentally visualize. Imagining is a powerful way of projecting yourself into hypothetical situations and mentally experiencing them. A developed imagination can be a source of creative visions. Imagery can be used as a mental simulation of an experience or situation, involving all the senses.

EVALUATE: To determine or fix the value of, to examine and judge, to estimate. Evaluation, like analysis and synthesis, is really a metaheuristic and a phase of problem-solving. Evaluating involves primarily testing against some standard of values and comparing, making a selection. Evaluation is a critical step in the feedback loop in heuristic behavior.

DEFER: To put off, to postpone, to delay (in reference to evaluation or judgment). Deferring judgment or evaluation is an important strategy during periods of alternative generation as it permits you to concentrate on "thinking up" ideas and not worrying about their ultimate quality. Deferred judgment encourages a positive environment and attitude and prevents budding ideas from being thrown out too soon.

EXPERIENCE: To consciously perceive or apprehend reality or an external, bodily, or psychic event, to directly participate, to have or make an experience. Experiencing in this context means to become as intimately and directly involved with the problem and the problem-solving process in order to have a rich source of information from which to draw. The more intense the experience and the more senses it involves, the more likely you are to remember it and derive useful information from it at a later date.

RECALL: To call back, to bring back to mind, to remember. Recalling or remembering is the basic process by which we can learn and retrieve information from previous experiences and may in fact be similar to the original act of perception. Many of these strategies can be used to aid recall, and the development of our powers of memory can be an invaluable help in problem-solving.

FORCE: To attain or to effect against resistance or inertia, to hasten the rate of progress or growth of, to make a great effort to. Forcing as a strategy refers to pushing an issue in a problem as far as it can go in order to investigate its validity. "Force-fitting" is the process of trying to relate a seemingly unrelated idea to the problem in searching for new points of view (see analogy and synectics). Forcing also refers to forcing oneself to continue to follow a given procedure, especially in alternative generation, as we often give up too soon.

RELAX: To make less tense or rigid, to become lax, weak, or loose, to seek rest or recreation. Relaxing is the process of releasing mental and physical tension and is often essential for free and innovative thinking. Because of the strong relationship of mind to body, knowing how to physically relax is important, and you should seek a balance between uptightness and total collapse and lack of attention.

INCREASE: To make greater, to enlarge, to exaggerate. Increasing refers here to exaggerating and making more definite as in a feature of a design in order to make a stronger statement and to more easily detect and examine the effect of a particular variable. It is the process of moving away from the neutral to the upper limit.
DECREASE: To cause to grow less, to reduce, to lessen, to diminish. Decreasing refers in this context to lessening the effect of a particular variable in the problem, reducing it towards total elimination. Increase and decrease refer to the process of levelling and sharpening as described in cybernetics.

INCUBATE: To maintain under conditions favorable for hatching, development, or reaction, to cause to develop, to mull over, to "sleep on it." Incubation has been recognized as a common phase in problem-solving, and there is evidence that strategies and plans continue to operate on the problem subconsciously during these periods, sometimes resulting in insight or a sudden transformation.
PURGE: To get rid of, to eliminate, to get out of your system. Purging is the process of getting rid of immediate ideas and preconceptions by expressing them and writing them down. Purging seems to result in a definite psychic release from the strain of having to consider and remember something. You then feel free to explore other alternatives before evaluation.

INTUIT: To immediately apprehend, to directly know or decide without rational thought and inference, to feel. Intuition is a valuable process in problem-solving as it is a spontaneous result of all your past experiences and may well include factors that you have not consciously considered. Intuitive solutions are immediate responses to the problem and should be listened to but not accepted unconditionally.
RATIONALIZE: To make conformable with rational principles, to substitute a natural for a supernatural explanation, to be explicit and to try to understand, to justify. In problem-solving rationalizing is the process of trying to explain as rationally and explicitly as possible all your ideas and actions. To do so you must try to become aware and self-conscious of what you are doing in order to communicate your reasons behind decisions to others.

INVOLVE: To enfold or envelop so as to encumber, to draw in as a participant, to occupy absorbingly. Total involvement with a problem means to eat, sleep, and dream about it, to in effect become the problem. Periods of this kind of total absorption and empathy can be very productive because everything you experience becomes related to the problem, and chance happenings can lead to new insights. Involvement can be initiated by simply leaping in and getting "your feet wet".
DETACH: To separate from a larger mass, to disentangle, to withdraw. Detachment of yourself from a problem is a useful way to clear your head, to get away from the problem and see it in perspective. Detachment enhances incubation and also removes you from overweighted priorities and considerations.

LEARN: To gain knowledge or understanding of or skill in by study, instruction, or experience, to come to realize, to discover. Learning in problem-solving means to be aware of your own strategies and constantly looking for new ones. To learn a strategy, you must perceive it, understand it conceptually and then apply it in many different problem contexts. Over-learning is the process of practicing something so many times it becomes a skill.
TEACH: To cause to know, to instruct by precept, example, or experience, to educate. Teaching problem-solving abilities to yourself or to others is a strategy for improvement and should involve a conceptual understanding of the nature of problem-solving, a knowledge of the individual strategies, and experience of using these heuristics successfully in many different kinds of problems.

LIST: To put down, to enumerate, to record in abbreviated form. Listing is the simplest strategy for recording ideas, numbers, and other items of information: writing them down one after another. Once pieces of information have been recorded in a list, they can later be recalled, organized, or evaluated. A list is the easiest form of graphic display to search.
CHECK: To compare with a source, original, or authority, to verify, to review. Checking in problem-solving refers especially to the process of making and using check lists, reminders of operations to perform, issues to consider, and spontaneous ideas to include. Checking involves comparing what has been done with some statement of what should be done, and some systematic procedures can avoid great errors and lost time in dealing with complicated problems.

MOTIVATE: To offer incentive, to induce, to entice, to encourage to do something. Motivation and desire to solve in problem-solving are critical factors, and it is good to develop ways of enticing yourself and others to plow through the more laborious phases of problem-solving. You must want to solve a problem. You can overcome the initial fear of the unknown and possible failure often by simply leaping in and getting started.
PRACTICE: To perform or work at repeatedly so as to become proficient, to train by repeated exercise, to perform often, customarily, or habitually. Practice is a principal strategy for learning a process or skill through repeatedly performing it, ideally in a variety of situations, and thus developing a generalized cognitive structure, pattern of behavior, or conditioned response.

SIMULATE: To give the appearance or effect of, to develop a model, to translate into other terms or media. Simulation is the process of developing a model of the problem situation on which you can test alternative solutions and predict outcomes. Models can rnage from simple cardboard models of a building (iconic) to sophisticated computer models of transportation networks (symbolic). A model is in a sense an image or representation of reality and should behave analogously, in some way like its real counterpart. At least a crude kind of representation may be necessary in most problem-solving.

TEST: To try, to experiment, to verify, to compare. Testing is basically the process of performing an operation on something and then comparing the results against some standard of expectation. The test phase can be considered the comparison stage before evaluation and forms a critical link in the feedback loop in heuristic behavior.

START: To perform the first stages or actions of, to cause to move, act, or operate, to begin. Starting in problem-solving is the act of initiating a process. While seeming a simple concept, the sense of when to start and what to start and the courage to actually start is a constantly troublesome issue.

STOP: To discontinue, to cease, to desist. Stopping in problem-solving is the strategy of constantly checking to see if you should stop a particular approach and start another. The sense of when to give stop orders is another necessary issue in problem-solving; to stop too soon may mean failure but not to stop may mean futile waste of time.

SYSTEMIZE: To develop an organized procedure, to arrange methodologically, to make into a system. A systematic strategy in problem-solving is a procedure which follows a given set of steps and can guarantee to completely search a set of alternatives if completed. It is generally algorithmic in nature, rigid, and often lengthy to implement, but it does not involve much risk.

RANDOMIZE: To arrange tests, samples, and other factors so as to simulate a chance distribution, to proceed without a plan and by chance. Randomization is a strategy to reduce systematic errors in a procedure. In this sense it can be used to overcome fixation by randomly selecting a piece of information and trying to "force-fit" it into relevance to the problem, or what has been called lateral thinking. Randomness induces chance, and chance has played a large role in the history of invention.

TRANSFORM: To change in composition or structure, to change in character or condition, to make go from one state into another. Transformations are operations or rules governing change from one state or position into another. In a sense, all strategies can be considered transformations on the problem state. Transformations can convert information into new or original forms.

MANIPULATE: To treat or operate with the hands or by mechanical means, to move around, to change position. Manipulation in problem-solving is a particular set of transformations that pertain to the changing of physical position or relationship of entities, especially symbols. Manipulating can become a heuristic strategy when followed by an evaluation after each change, and as such accounts for a lot of our trial and error procedures in literary and graphic composition.

VERBALIZE: To express in words, to describe verbally. Verbalizing is the process of explaining something in words, and in doing so can be considered a strategy for forcing yourself to be explicit. Verbal communication is the most common medium in a highly literate society like ours.
VISUALIZE: To make visual, to see or form a mental image, to describe graphically. Visualization is a process of seeing or describing things in terms of perceptual images, and is a very powerful, dense, and often underdeveloped ability. Where physical relationships and aspects of design are to be studied or communicated, visualizing is a necessity.

WORK FORWARDS: To proceed conceptually from where you are to where you are going, from the problem to the solution, to work inductively. Working forwards seems so obvious at first that we forget that there are other basic strategies. Induction is basic to the scientific method and is required to build a logically watertight argument.
WORK BACKWARDS: To proceed conceptually from where you are going back to where you are now, to go from the solution state back to the problem state, to work deductively. Working backwards is a powerful strategy when you know roughly what the solution should be but don't know how to get there. Working backwards can be used in conjunction with working forwards to narrow the difference between the problem state and the solution state until you can conceptually bridge the gap.

WORK IN: To close in from outside, to narrow the scope, to limit. Working in is the strategy behind linear programming or the limiting of solution space by examining constraints. Often you know more about what is not the solution than what is and thus can dramatically limit the range of possibilities by considering first what you know cannot solve the problem.
WORK OUT: To develop incrementally, to grow, to proceed from a core and move out. Working out as a strategy in problem-solving involves starting with what you know must exist and slowly building on that. It is extremely useful in complex situations and can provide a first foothold on the problem.

APPENDIX II - COURSE OUTLINE

UNIT A	INTRODUCTION TO TOOLS FOR CHANGE
UNIT B	INTRODUCTION TO FEEDBACK AND META-HEURISTICS
UNIT C	LEARNING TO LEARN
UNIT D	GROUP PROBLEM-SOLVING
UNIT E	SEEING AND REMEMBERING
UNIT F	GRAPHIC DESIGN AND ORIGINALITY
UNIT G	IMAGERY
UNIT H	LOGIC AND RATIONAL THOUGHT
UNIT I	PLANNING AND PREDICTION
UNIT J	FINDING AND KEEPING INFORMATION
UNIT K	SIMULATION AND EVALUATION

INTRODUCTION TO TOOLS FOR CHANGE
UNIT A
SECTION I

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Playing Games Arrange classroom to facilitate natural groupings and distribution of games. As students arrive direct them to games representative of all those to be used during semester. Move about room observing, joining games, answering questions, and introducing class to tape recorder.	Games Representative games of all those to be included in course	
Discussion - What's It All About? As students are becoming involved in games, introduce yourself and begin informal discussion of what the course is all about. Point out that we are going to be using games extensively as contexts to examine the process of thinking. Ask them to begin to familiarize themselves with a variety of games. Stress that in this class "winning" is not so important. We are more interested in how you are playing a game than how well you are playing. As facilitators, we are here to help students share experiences in thought, not to tell them what to think.		School Learning how not what.
Common Experience - The Changing World Show film that presents how fast our civilization and specifically technology is changing	Film A film on the advance of technology and the world	Life World problems, community of man.
Discussion - How Do You Prepare Yourself for Change? What is change: a difference between A and B. What produces change: actions. Actions that produce characteristic changes are called processes: physical processes and mental processes. A certain set of mental processes which we will discover together we call "tools for change." Learning these may be the best way of preparing for the future. Define problem briefly as something that needs to be changed. Give description of Tools for Change: twice weekly, no grades, experiential learning, synthesizing curriculum, attacking problems, sharing.		

INTRODUCTION TO TOOLS FOR CHANGE
UNIT A
SECTION II

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Awareness of Strategies Begin by playing games of choice in natural groupings. Ask class to be aware of what games they enjoy and are better at than others. Ask them to become conscious of how they are playing a game: what strategies or tricks they are using. Change games several times. Don't worry about finishing or winning, we will have times for this later.	Games and Puzzles Some of the simpler games like Twenty Questions. Scrabble, etc. and puzzles like Instant Insanity, Fascination Cube, etc.	
Discussion - What Strategies Did You Use? Form large group and ask class for a partial list of strategies. As each strategy is offered, ask for an example of its use in game and elsewhere. Write all down on large sheet of newsprint. Show how several strategies can be grouped together. Relate to major heuristics. Make demonstration strategy sheet. Stress fact that we are revealing strategies most of which they already use, not presenting them with totally new ones.		Life Other contexts for strategy use.
Common Experience - Small Group Roles Demonstrate and explain roles of observers, transcribers, and facilitators. Demonstrate different ways of recording: tape, photographs, TV, etc.	Demonstration Facilitators demonstrate roles in game playing and problem-solving.	
Discussion - Class as Creative Resource Explain that on Problem Days we will be tackling real problems. Some of the solutions we generate will go to school administrators and some we will implement ourselves.		School and Community Problems that class could try to solve.
Common Experience - Problems to Tackle Spend rest of class generating as a group useful problems to solve this semester. Defer judgment and record.		

INTRODUCTION TO FEEDBACK AND META-HEURISTICS
UNIT B
SECTION I

PROCESS GUIDES: CHANGE-VARY, CYCLE-REPEAT, START-STOP

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - How Do You Use a Strategy? Divide up into small groups, which are, in turn, dividedinto "observers" and "players." Each group plays several games during period, members switching between playing and observing. Ask group to make lists of strategies and observe how they used them. What patterns or sequences do they notice? Tape selected groups.	Games Trial and Balance, tower building with blocks, Submarine, Inquiry Box, anagram problems, dart throwing, frustration ball, (or some other game of physical skill).	
Strategies to Control Strategies Ask the students for lists of strategies. How did they move between strategies? Did they notice any sequences? Introduce idea of meta-heuristics and illustrate typical use in games played. Refer to tape recordings.		
Common Experience - Demonstration Using game of Krazy Legs, demonstrate how strategies are used in different sequences. Make these patterns of movement visual. Link motions to meta-heuristics.	Game Krazy Legs	
Discussion - What is Feedback? Introduce concept of feedback in relation to heuristics: each action must be followed by a reaction. Present general model of problem-solving: Concept Formulation, Implementation, Evaluation. What would happen if there was no feedback?		Working Model Stimulus-response, Tote structure, intelligence
Common Experience - Can You Do Without It? Play same games as before but with restrictions on feedback: eyes closed, no response, etc.	Games Same as above.	
Discussion - Looking for Feedback Ask students to look for various kinds of feedback in school and home life. How important is formal feedback like grades and approval? Make lists for next time.		

INTRODUCTION TO FEEDBACK AND META-HEURISTICS
UNIT B
SECTION II

PROCESS GUIDES: CHANGE-VARY, CYCLE-REPEAT, START-STOP

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Feedback in Life Present films that illustrate feedback situation, action-reaction, learning cycle, clear change strategy. Ask students to be aware of processes they have learned.	Film Animals in maze learning, men learning in space, film on teaching machines, cartoon of action-reaction (Roadrunner).	
Discussion - How Do We Learn? Ask students to identify meta-heuristics and feedback situations in films. Point out importance of feedback in learning cycle and intelligent behavior. Ask for homework examples. Raise question of time element in cycle: letter vs. telephone call.		Working Model Learning Cycle, mediation between stimulus and response
Common Experience - Time Element in Feedback Work for a while on problems that are dependent on how long it takes to get response. Point out that speed in learning and playing varies with time span of cycle.	Problems Explaining things in various media (paper, words, sign language), finding something with eyes closed and opened, etc.	Life Communication.
Discussion - Algorithm Vs. Heuristic Review concept of heuristic strategy. Compare with algorithmic strategy: inflexible, does not adapt with progress. Define open-ended and closed-ended problems in terms of games that have been played.		Working Model Information processing.
Common Experience - Machine Vs. Human Play games where you have to tell your partner, who is a machine, how to play: machine can only follow rules.	Games Become a machine-human in simple games that have been played before.	
Discussion - Need for Awareness of Process Discuss concept of orchestration of process repertoire. Analogy of carpenter's tools: tools for change. Process bias. Introduce or select problem for Problem Day.		

INTRODUCTION TO FEEDBACK AND META-HEURISTICS
UNIT B
SECTION III PROBLEM DAY

PROCESS GUIDES: CYCLE-REPEAT, START-STOP
CHANGE-VARY

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Discussion - Introduction to Problem and Procedures Discuss briefly procedure of developing a display as record. Important to have a record of progress of problem-solving as well as list of all ideas generated: something to show for work and ultimately to give to those people who need the solutions. Problem Solving Session For first project, try to keep a large group, leading them through all basic phases of problem-solving: problem perception, problem definition, planning, alternative generation, evaluation, synthesis. Act as facilitator, keeping things moving so that experience can be completed in period. Use meta-heuristics as commands to students to keep them moving around issues: "Let's cycle, let's repeat that approach," etc. Keep record of display sheets and ask a few students to help. Tape record. Discussion - Review Summarize session and solutions. Ask students to discuss how they might implement solutions.	Problem Student-faculty interaction, or some other aspect of feedback in education.	

LEARNING TO LEARN
UNIT C
SECTION I

PROCESS GUIDES: LEARN-TEACH, PLAY-PRACTICE, FOCUS-RELEASE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - I'll Bet You Can't Play games and tackle problems that involve learning a particular skill. Have observers carefully note how the learner is approaching problem. Take pictures or use video tape to record significant steps.	Games and Problems Games of skill: darts, juggling; learning alphabet in binary code, learning Morse code.	
Discussion - How Do We Learn? Ask students for learning strategies. Point out incidences of the major heuristics. Discuss analysis-synthesis cycle in learning: thinking about doing and doing. Refer to ideas about conscious-unconscious relationships. Talk about skill learning: developing patterns of behavior. Example: learning to drive car. Discuss the hierarchical nature of sub-skills.		Working Model Conscious-unconscious, skill learning hierarchical structure.
Common Experience - Trying to Teach Use same games or tricks that particular students have learned and ask them to try to teach another person. Have the learner comment at the end about how well the teacher succeeded.	Games and Problems Same as above or individual tricks.	
Discussion - Teaching Strategies Begin discussion about different ways of teaching: how should material be structured, if at all? Introduce concept of educational methods spectrum: passive sensory to active experiential. Discuss relationship between amount of information to be communicated and method most effective. Ask students to observe teaching strategies and comment for next time.		School Learning experiences.

LEARNING TO LEARN
UNIT C
SECTION II

PROCESS GUIDES: LEARN-TEACH, PLAY-PRACTICE, FOCUS-RELEASE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Learning for Keeps Show films on training programs of various kinds. Ask students to observe teaching strategies and ways of presenting material. Relate to previous discussions.	Films Pilot training, machinist training, athletic training.	
Discussion - Discovery Learning Review films. Point out how in specific training programs efficiency in teaching can be high. Discuss intensive training programs; Monterey, bootcamp, etc. Introduce opposite concept of discovery learning: intensity of finding out for yourself. Relate to games.		School Programmed learning.
Demonstration - Learning Vs. Understanding Ask some questions of the class that relate to material that may have been learned in rote form without total comprehension. Point out that learning is a relative term. To test whether you really understand concept, try to teach it to someone else. Teaching is the best way of learning.	Questions About concepts already discussed; how combustion engine really works, what are light rays, etc.	
Discussion - Orchestrating Your Life Initiate general discussion about controlling approaches to life, building in contrast. Introduce concept of focus-release as wave pattern of contrast: work and play. Awareness of process leads to orchestration of points of view in thinking: flexibility. Control does not mean always in control; you can be consciously out of control. Illustrate importance of play as learning heuristic and relate to childhood concept formulation. Review discussion of learning and tell students that these concepts will be discussed many times in context of following units. Decide on problem for Problem Day.		Life Life styles, learning to live fully.

LEARNING TO LEARN
UNIT C
SECTION III PROBLEM DAY

PROCESS GUIDES: LEARN-TEACH, PLAY-PRACTICE, FOCUS-RELEASE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Discussion - Presentation of Problem Use problem that relates to increasing effectiveness of learning in some school program. Use material of unit to set guides and to focus discussion. Ideally select problem that is presently being faced by school administrators. Stress the fact that solutions should be able to be tested by students: that problem is serious one and that their suggestions and solutions will be taken seriously. Perhaps invite school official who is most concerned about problem.	Problem To be chosen by class. Related to school programs.	

GROUP PROBLEM-SOLVING
UNIT D
SECTION II

PROCESS GUIDES: ANALOGY-BRAINSTORM, INCUBATE-PURGE, EVALUATE-DEFER, INVOLVE-DETACH

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Synectics Session Facilitators conduct a formal problem-solving session according to Synectics model (excursion, etc.) Class is divided in half: participants and observers. Entire session is taped.	Problem Generated by students.	Synectics, Inc.
Discussion - Brainstorming and Excursions Review session and summarize roles and procedures. Discuss brainstorming rules: deferment of judgment, quality as a function of quantity, spontaneity. What purpose does excursion serve? Getting away from problem block, incubating, finding analogies, and returning to problem. We often use analogy. Are there different types?		
Common Experience - Making it Strange List and explain different types of analogy; common, personal, symbolic. Play dancing boxes three times - once for each type of analogy. How can we make the familiar strange...the strange familiar? List examples.	Games Dancing boxes, Making familiar strange, Marking strange familiar.	
Discussion - Application to Life Relate analogy types to formal synectics session. How were they used? (Refer to recording). Discuss application of group problem-solving methods to personal, school, community, and world problems. Interrelate process guides as summary to unit. Can't brainstorm without purging, involving, deferring judgment. Analogy is for detaching and incubating. Evaluation is for synthesizing.		School Other subjects Life Engineers, family, City council, U.N., others.

GROUP PROBLEM-SOLVING
UNIT D
SECTION III PROBLEM DAY

PROCESS GUIDES: ANALOGY-BRAINSTORM, INCUBATE-PURGE, EVALUATE-DEFER, INVOLVE-DETACH

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Real Problem Participants are given problem without any further instructions. See if group can conduct own problem-solving session. Tape recorders and paper are available. Watch for small groups, use of process guides, synectics procedures, etc. Discussion - Summary Review and evaluate solution(s) and plan implementation. Where to get materials, etc.? Discuss groups' reactions to lack of instructions and how group problem-solving methods were or were not employed.	Problem Design a temporary, cheap mobile classroom environment for use in this course.	Environmental design.

SEEING AND REMEMBERING
UNIT E
SECTION I

PROCESS GUIDES: EXPERIENCE-RECALL
CONSCIOUS-UNCONSCIOUS

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Seeing and Describing Begin by presenting students with an interesting object. Ask them simply to look at it for a while. After five minutes or so, take it away and ask them to describe it by words or pictures. Ask them detailed questions about the object. Then present object again and have them revise and complete their descriptions.	Problem Interesting objects like artichokes, driftwood, mechanical objects.	
Discussion - What is Noticing? Ask students to explain differences between first and second descriptions. Point out that noticing is a constructive act: have to look for something to notice it. Discuss some basic facts about vision: primary and secondary processes, feature analyzing.		Working Model Theories of vision.
Common Experience - Learning About the Eye Show slides or displays with various visual experiments: foreground-background, context-dependence, pattern recognition, comparisons. Point out how the eye does not see all that it could. It is a very subjective and educated instrument. Figural fixation.	Slides or Charts Visual experiments: kissing vase, old lady-young girl, etc.	
Common Experience - Patterns Introduce various objects, pictures, situations and ask students what they see. Show how training and previous experience govern how they look at objects and in terms of what patterns they store the information.	Slides and Objects Pictures of machines, game boards, mathematics, etc., (covering diversity of content areas).	Education Experience vs. abilities.
Discussion - Learning to See Discuss, with reference to earlier problems, how you can learn to see by developing particular ways of looking at things. How understanding of what you are seeing helps to see. Discuss relationship of conscious and unconscious observations. Ask students to notice what they have been trained to see, and what they have not.		

SEEING AND REMEMBERING - PROCESS OUTCOME - EXPERIENCE-RECALL
UNIT E CONSCIOUS-UNCONSCIOUS
SECTION II

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Vision in Use Present films about facts of seeing and how these are made use of in the world. Show how police can mock-up criminals' images from traces of memory, subliminal advertising, etc. Ask students to think of how each fact of vision affects their own lives.	Films Visual experiments, studies in visual fixation, police mock-ups, pattern recognition devices.	
Discussion - Experience of Seeing Discuss fact that we remember the act of reconstructing image, not image itself. Ask students to remember something, and show how they have to re-experience to remember. Show how the more intense the experience, the more vivid the memory. Ask students to share some intense images from their own lives. How could we increase the likelihood of remembering something?		Working Model Memory as trace.
Common Experience - Memorizing Play memory games that involve several of the senses. Ask students to note what strategy/trick they used to increase memory.	Games "In my bag I packed..." What did you do on the day of..., How many..., etc.	
Discussion - Learning to Remember Make list of memory aids. Look at each in terms of what has been said about perception. Stress relationship of perception and memory. Importance of patterns and ways of coding information: grouping.		Working Model Coding of information.
Common Experience - Memorizing Return to games and ask students to try to employ some of the aids.	Games Same as above.	
Discussion - Importance of Memory Point out where memory is useful and where it is more important to be able to know how to reconstruct image. Rote learning vs. constructive understanding. Review basic ideas about perception and memory and relate to school. Select problem for Problem Day.		School Memorizing vs. constructing.

SEEING AND REMEMBERING
UNIT E
SECTION III PROBLEM DAY

PROCESS GUIDES: EXPERIENCE-RECALL
CONSCIOUS-UNCONSCIOUS

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Discussion Use some problem that involves increasing awareness of something important within school. For example, awareness of racial tension, student dissatisfaction. Generate ways that these issues can be noticed and either avoided or encouraged. Use examples from school history to test ideas. Work out ways to try to implement ideas.	Problem To be decided.	

GRAPHIC DESIGN AND ORIGINALITY
UNIT F
SECTION I

PROCESS GUIDES: DISPLAY-ORGANIZE, TRANSFORM-MANIPULA
ADD-SUBTRACT, ADAPT-SUBSTITUTE,
COMBINE-SEPARATE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Manipulation Begin by playing games. All involve manipulating physical elements. Games are mostly individual games so perhaps best for students to pair up. (observer-player). Ask them to play at least three games and to look for common strategies in the way they approach the problems and handle the elements. Ask them to keep a list of strategies. Ask them to switch between doing the problem in their heads, on paper, and by physical manipulation of objects. Record differences in ease, speed, and strategy.	Games One and two dimensional puzzle games, Insanity blocks, mixed word phrases, problem factoring equations, sorting games, game of passing around a drawing; each person adding to design.	
Discussion - The Power of Graphics As a group, make a list of basic manipulation strategies. Refer to games and records of activities. Discuss differences between working in head, on paper, and physical manipulation. Power of graphics involved with memory, informational density, and ease of heuristically applying strategies. Refer to layout problem. Discuss concept of manipulation. Begin lists of aids to manipulation and kinds of displays.		Working Model Short-term memory pattern recognition. Memory function of display.
Common Experience - More Manipulation Go back to playing original games or one of the basic strategy games. Ask them to refer to master list of manipulation strategies and to actively discuss use.	Games Same as above or basic strategy games.	
Suggestion for Preparing for Next Day Ask students to observe various kinds of manipulation strategies in other courses. Look also for various kinds of displays (newspaper, road signs, television) and to ask how they could aid in problem-solving.		School Courses Math., Art, English, et Life Display devices.

GRAPHIC DESIGN AND ORIGINALITY
UNIT F
SECTION II

PROCESS GUIDES: DISPLAY-ORGANIZE, TRANSFORM-MANIPULA
ADD-SUBTRACT, ADAPT-SUBSTITUTE,
COMBINE-SEPARATE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Displays in Life Begin with films relating to display and display manipulation. Also films that show the growth of form in organism and in the arts. Additive and subtractive growth. (May be in two parts with discussion in between).	Film Film on signs of all kinds, film of active symbol manipulation (score boards, schedules, etc.), interactive computer films, films on organic growth: trees, ice crystals, erosion, buildings, sculpture, painting, (dynamic films).	
Discussion - Speeding up Problem-Solving Discuss films on displays and identify basic heuristics. Relate to problem-solving cycle and show how it is sped up by automating manipulation or implementation phase. Ask for examples from homework and make large master list. Ask for basic power of each item in terms of heuristics.		Problem-Solving Cycle Interaction.
Discussion - Development of Design Introduce idea of interaction with computers. Discuss basic strategies of design development: additive and subtractive. Relate to life processes and to films. Discuss heuristic combination of cutting out and manipulation in terms of editing process.		Life Growth, destruction. School Paper writing, art, editing.
Common Experience - Designing Play games in groups. Games are design games with varying kinds of materials, elements, purposes, and limitations. Ask students to refer to master list of manipulation strategies and note differences when they change the nature of the design problem. Organize so that some variables stay fixed while others change. Record designs with paper and Polaroid cameras.	Design Games Kit with various material, objectives, and constraints, (basic elements, parts, blocks, or clay; something particular or whatever they decide; limited size or unlimited size).	
Discussion - Originality Can be Learned End by displaying designs and identifying certain basic patterns and growth forms. Select Problem Day project and location. Discuss originality as mastery of manipulation strategies - something that can be learned.		Working Model References to course in training originality and creativity - problem-solving.

GRAPHIC DESIGN AND ORIGINALITY
UNIT F
SECTION III PROBLEM DAY

PROCESS GUIDES: DISPLAY-ORGANIZE, TRANSFORM-MANIPULAT
ADD-SUBTRACT, ADAPT-SUBSTITUTE,
COMBINE-SEPARATE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Discussion Introduction of problem or generation of problem: a design problem that either relates to something the students want or the school wants, or a totally fun game. If the latter, it might be held outside classroom, such as on the mud flats or a junk yard. In any case, records will be kept on paper and film, and a final display produced. Not much focus will be placed on observation, but the progress of the problem will be reviewed at the end or the beginning of the next day.	Design Problem To be chosen by class.	

IMAGERY
UNIT G
SECTION I

PROCESS GUIDES: DREAM-IMAGINE, INTUIT-RATIONALIZE, VERBALIZE-VISUALIZE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Day Dreaming Ask students to find a comfortable position in the classroom and become quiet. Suggest they slowly relax into day dreaming. No stimulus or set is given. Stop dreaming. Ask whether they were able to imagine or if minds were just wandering. Introduce music as set or focus. Class returns to day dreaming until discussion time.	Day Dreaming Musical recordings: Debussy, R. Strauss, Bach.	
Discussion - Types of Dreams Exchange dreams. How does relaxing effect dreams? Was music helpful? Introduce the different kinds of dreams - hypnagogic, day and night, and dreaming up. Give examples of each. How could dreaming be used as a tool?		Working Model Hypnagogic dreams, Subconscious.
Common Experience - Putting Dreams in Action Students are asked again to relax into dreaming. Set is introduced: "You are walking down a lonely beach on a windy day, a gull swoops low and you climb on its back." Ask class to express themselves: become your dream, build your dream, draw it, etc. A wide variety of art media are available: modular building systems, clay, junk, paint, glue, musical instruments, etc. Expressions are shared, recorded and/or photographed.	Dream Art, Music, etc.	
Discussion - How Well Can Dreams be Communicated? As a group talk about the various dream expressions. How well did they communicate? To self? To others? What is the power of graphics and other aids? Relate to change, sculpture, painting, combination of these.		
Suggestion Try hypnagogic dreaming and be aware of your night dreams. Jot them down if it helps.		

IMAGERY
UNIT G
SECTION II

GUIDES: DEF[illegible] IMAGE, IN[illegible]ALIZE
VISUALIZE-VERBAL

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Films on Creativity Two films are shown: one showing an artist in process of creating, the other to induce or stimulate imagination.	Films Film of an artist and a fantasy film.	
Discussion - Imagination in the Arts What did these films communicate? How was it done? Talk about the power and limitations of film as a communicator of imagery. Power: combination of visual and verbal, can change focus quickly. Limitations: visually restricted to two dimensions and once produced is static presentation of idea. Focus discussion on verbal and visual aspect of communication in general. Introduce the idea of an artist's creation as the rationalization of his ideas, dreams. Discuss different types of art as expressions of different rationals. Talk about multi-media as technological innovation in the arts.		Fine Arts Psychedelia Light shows, The Hobbit, Narnia books Science fiction, Mad Magazine, comics, cartoons
Common Experience - Using Dreams in Problems Students are divided into small groups and asked to pick one of the design problems. Class is reminded of the tools of deferring judgment, incubating, purging. Class spends a few minutes dreaming about them, and then exchanges ideas in groups. These are incorporated into the solutions of the design.	Design Problem Magical Energy Mechanism. Mystical Survival Machine. Magical Mystery Tour.	
Discussion - Presenting Solutions Groups present design to each other and a discussion follows on the effectiveness of graphic and verbal presentations. Students are asked to consider application of imagery tools to other areas of self, school, community, world, etc.		Life Designers, economists, researchers. School Math, biology, et..
Suggestion Practice dream awareness and try hynagogic dreaming again.		

IMAGERY
UNIT G
SECTION III PROBLEM DAY

PROCESS GUIDES: DREAM-IMAGINE, INTUIT-RATIONALIZE
VERBALIZE-VISUALIZE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Real Problem Class initially attacks problem of their own choice as a large group, then breaks down into small groups to work out specific areas. All sessions are recorded (paper, tape, TV, etc.). Discussion - Sharing Solutions Groups share solutions and integrate ideas for implementation.	Real Problem Possibilities: Alternative to textbooks, New transportation system, Alternative to drugs.	

LOGIC AND RATIONAL THOUGHT
UNIT H
SECTION I

PROCESS GUIDES: ANALYZE-SYNTHESIZE, DEFINE-SYMBOLIZE
WORK IN-WORK OUT, WORK FORWARD-
WORK BACKWARD

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Figuring It Out. Play games that involve clarity of thinking and logic. Stress fact that many of the problems may not be solved within period, but to record what kinds of strategies they used. Divide into players and observers.	Games and Problems Two trains problem, Three knives problem, Spoon puzzle, Hi-Q, Puzzle rings, Hangman, Twenty Questions.	
Discussion - How Did You Do It? Stop playing briefly to make list of some of the strategies. Introduce concept of defining: what are you really trying to do?		
Common Experience - More Figuring Out. Go back to same games trying to consciously use some of strategies that were listed.	Games and Problems Same as above.	
Discussion - Definition and Redefinition Discuss concept of solution space: that definitions are boundaries; relationship between definition and solution. Generate ways of defining: who, what, when, where. Importance of redefinition and flexibility of thinking. Getting everything down. Polya's basic questions. Put down all assumptions, information, etc.		School Mathematics, Sciences. Problem-Solving Previous heuristics, especially Question-Assume.
Common Experience - Solving Together Take problem that can be cracked by definition and work together on it, pointing out processes that have been discussed. Stress importance of proceeding in small steps and not leaping to conclusions. Suggestions for preparation for next day: watch mystery program on TV or read mystery story. Record important strategies of definition and logic.	Problem Geometry problem, outlining a paper, structuring some general urban question.	World Mysteries

LOGIC AND RATIONAL THOUGHT
UNIT H
SECTION II

PROCESS GUIDES: ANALYZE-SYNTHESIZE, DEFINE-SYMBOLIZE, WORK IN-WORK OUT, WORK FORWARD-WORK BACKWARD

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Breaking Down and Building Up Show films of scientific work, and films of things being created and synthesized: elapsed time shots. Ask students to look for basic processes.	Films Discovery of a protein, tracking down a disease, elapsed time shots of building, shots of juggler.	
Discussion - Simultaneity and Synthesis Discuss films in terms of processes already covered. Ask for homework examples of mystery solving. Introduce conflict between step-by-step thought and simultaneous view and solutions: can't be every place at once. Importance of cycling. Show synthesis to be originality on larger scale; putting together pieces of solutions. Discuss problem-solving of complex problems: need to break down and build up. Generate ways of keeping things progressing in parallel.		Working Model Parallel and sequential processing, conscious thought as single focus.
Common Experience - Everywhere at Once Play games for a short while that involve trying to be everywhere at once. Show that cycling is only way to attend to many things "simultaneously."	Games Juggling, Double Solitaire, three tops at the same time.	
Common Experience - Parallel Thoughts Attack together some problem of complexity, break into groups and develop alternative solutions in parallel. Defer judgment until comparison at end of period. Some groups work back from ideal solution, others build up from what they know. Decide on problem for Problem Day.	Problem Three ways to make fresh water (air, soil, salt water).	

LOGIC AND RATIONAL THOUGHT
UNIT H
SECTION III PROBLEM DAY

PROCESS GUIDES: ANALYZE-SYNTHESIZE, DEFINE-SYMBOLIZE
WORK IN-WORK OUT, WORK FORWARD-
WORK BACKWARD

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Discussion - Presentation of Problem Take some problem that students have chosen: something that is reasonably complex but is within experience of all the members of the class. Decide on some subproblem and break into task force groups. Spend half the period on analyzing each of the subproblems, not trying to generate any solutions. The second half of the period, stop, review analysis, generate some partial solutions, and have groups work on these separately for most of the rest of the time. At end, try to pull solutions together. If problem is really important to class, may be advisable to spend two days on it.	Problem To be chosen by class.	

PLANNING AND PREDICTION
UNIT I
SECTION I

PROCESS GUIDES: PLAN-PREDICT, ASSUME-QUESTION, DIAGRAM-CHART

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - What Are You Doing? Begin by all playing games of strategy. Introduce some new games in order to use the experience of explaining and learning a game as part of problem context. Stop games frequently, switching roles, predicting next moves or results, describing plans to others without reference to boards. Change constraints on games: for example, different kinds of scoring, ask for predicted changes in strategy, and then play a few rounds. Stop early in game period to ask for basic vocabulary established.	Games Tri-Nim, Submarine, 3-D, Tic-Tac-Toe, Tea Pot, Hangman, Chinese Checkers, and other basic strategy games.	
Discussion - Assumptions and Questions Discuss basic strategies and the intrinsic relationship between the first heuristics, i.e. you can't predict without assuming something. Importance of questioning and assuming.		
Common Experience - What Are You Assuming? Briefly, pair-off and get everyone to voice assumptions that they have about each other or something that they are related to. Then find truth through questioning. Compare results.	Games "Assumptions we make and questions we should ask."	
Discussion - Questions in Your Mind Stress importance of internal dialogue to successful problem-solving. Questions and answers lead to places you would not normally go. Refer to a few present and historical examples. Introduce concepts of plans with relation to heuristics. Introduce concept of hierarchical structure of plans: refer to examples of skill learning and previous games. Ask class to look for planning heuristics in their lives for next time, being conscious of assumptions and how their plans change with time.		Working Model Hierarchical structure of plan. Life History of inventions, unnecessary assumptions, changing plans.

PLANNING AND PREDICTION
UNIT I
SECTION II

PROCESS GUIDES: PLAN-PREDICT, ASSUME-QUESTION, DIAGRAM-CHART

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Planning in the World Begin with films of planning of large scale projects, cover basic areas of planning and major problems: population, urban growth, etc. Stress that heuristics involved with planning are by no means trivial. In major planning problems all of the heuristics can be used.	Films U.N. films of population growth and agriculture (starvation), polution film, film on planning of large industrial project (Jumbo Jets).	Life World problems, Industry.
Discussion - Visualizing Activities in Time Point out basic planning problems and use of prediction methods. Illustrate importance of graphic representation of activity over time: diagramming and charting. Refer to importance of schedules in life. Also, graphs. Introduce problem of fixation as major block to problem-solving. Illustrate basic kinds of fixation: functional, semantic, figural, and importance of the heuristic of questioning and internal dialogue in combating fixation.		Life Work scheduling.
Common Experience - Fixation Present a few fixation problems to be solved individually or in groups. Give hints in terms of heuristics.	Problems Man and Son, 3 Dot, 2 Containers, Cannibals and Missionary, mystery problems, etc.	
Discussion - Overcoming Mental Blocks Discuss problems and talk about fixations in general. Ask for other examples of wrong assumptions and narrow points of view. Review fact that awareness of process can help overcome periods of fixation.		
Common Experience - More Planning Return to basic games of strategy, encourage discussion of gaming in terms of planning heuristics.	Games Basic games of strategy: Chess, Go, Checkers, etc.	

PLANNING AND PREDICTION
UNIT I
SECTION III PROBLEM DAY

PROCESS GUIDES: PLAN-PREDICT, ASSUME-QUESTION, DIAGRAM-CHART

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Discussion Subject of problem will be chosen by students and and should in some way be meaningful and vital. Constraints can be made such that solutions can be implemented by students themselves or someone in the school system.	Planning for the Future Subject to be decided by the students.	

FINDING AND KEEPING INFORMATION
UNIT 3
SECTION I

PROCESS GUIDES: SEARCH-SELECT, RECORD-RETRIEVE, LIST-CHECK, COMPARE-RELATE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Finding the Right Thing Play games and work on problems that involve searching for things under different constraints and different requirements. Ask students to observe how they are proceeding and to keep account of their sequence of operations.	Games and Problems Selection problems (all A's, not including B's, but containing C's), finding town on world map, jigsaw puzzles.	
Discussion - Ways of Searching Ask for search strategies discovered in problems. Point out that, in one sense, all of problem-solving can be seen as searching for right answer. Introduce concept of random, heuristic, and algorithmic search: illustrate from games. Stress importance of a certain amount of consistency in search strategy. Discuss search problems in school and life. Recall discussion of graphics and memory.		Life Finding telephone number, address, etc.
Common Experience - Keeping Track Play games that involve keeping track of scores, moves, elements. Some of the time use paper and pencil; the rest of time try to do it in your head.	Games Scrabble, darts, cross-word puzzles, searching for numbers of hidden words.	
Discussion - Taking Little Steps at a Time Discuss importance of lists and checking: shopping, errands, ideas, etc. Need to get things down, sort them, and finally check. Importance of knowing where you are and where you are going. Notebooks as ways of recording.		Life Kind of lists: shopping errands, etc.
Common Experience - Getting Things Down Look at idea notebooks of famous men from different fields: show how first ideas are just jotted in any-old-way. Importance of carrying pieces of paper.	Exhibits Notebooks of Leonardo da Vinci, Corbusier, Einstein, etc.	
Discussion - For Next Time Ask students to be aware of ways they use lists in typical kinds of search problems.		

FINDING AND KEEPING INFORMATION
UNIT J
SECTION II

PROCESS GUIDES: SEARCH-SELECT, RECORD-RETRIEVE, LIST-CHECK, COMPARE-RELATE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Information Retrieval Show films on information retrieval systems of different kinds. Stress how just keeping track of information is becoming a fantastic problem. Ask students to relate processes to those they have already discovered.	Films Automated library systems, IBM info-retrieval systems, mail sorting, stock pile, inventory systems.	Life Industry and Computerization.
Discussion - Drowning in Information Discuss problems of access to the exact kind of information you are looking for. Compare computer access to memory access. What are associations? Discuss On-Line System at Stanford Institute. (Film if possible). Review powers of interactive systems. Talk about ways of storing information.		Working Model Association and memory vs. random access.
Common Experience - Design of a System Spend rest of period designing a little information retrieval system out of 3x5 cards, hole punch, and metal rods. Show how diversity of indexes helps to locate information rapidly.	Problem Design of Info-Retrieval System (cards, hole punch, rods).	
Discussion - Researching in General Discuss ways of taking notes that allow for reorganization. What are the trade offs of simple and complex systems. Set task force groups to research for Problem Day.		School Researching and note taking.

FINDING AND KEEPING INFORMATION
UNIT IV
SECTION III PROBLEM DAY

PROCESS GUIDES: SEARCH-SELECT, RECORD-RETRIEVE, LIST-CHECK, COMPARE-RELATE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Discussion and Presentation of Problem Review and organize information that was prepared by task force groups. Spend some time organizing it and relating it to problem. This could be part of a two-session Problem Day, this day devoted to organizing and analyzing of information, the next day to alternative generation. Problem could relate to issues of information access, like distributing information about half-way houses, free places to go to learn, or knowledge about some problem like drugs. Part of day could be spent on field trip, researching question.	Problem To be chosen by class. Especially related to increased access to relevant information.	

SIMULATION AND EVALUATION
UNIT K .
SECTION I

PROCESS GUIDES: SIMULATE-TEST, SYNTHESIZE-RANDOMIZE, MINIMIZE-MAXIMIZE, INCREASE-DECREASE, EXAGGERATE-UNDERSTATE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - A Game as Simulation Begin by playing various kinds of simulation games. Ask class to look for processes involved and how simulation is used. Look for common process between games. Point out that a game is a simulation. What is simulation: what is not?	Games Various kinds of simulation games: War, Politics, Monopoly, etc. Also, Charades.	
Discussion - Many Kinds of Models Ask for processes involved in the use of simulation. What is the power of a simulation? Introduce formal idea of a model and briefly illustrate various kinds: iconic, symbolic, numerical. Discuss basic qualities of models and essentials of design. Different uses: predictive, descriptive, instructional.		Life Kinds of Models.
Common Experience - Only One Chance Select a few of the simple puzzles or strategy games. Make constraints that only one actual trial can be made, and therefore some kind of simulation of problem must be made, tested, and predictions made before committing to actual trial. (May need to be demonstration, if class is not ready). Or perhaps, pose problem of what some complicated form looks like, encouraging some kind of direct model of situation.	Games Instant Insanity, Hi-Q, Two Container Problem, ten trees-five rows - four per row problem, etc.	
Discussion - Simulation in the World Begin search for kinds of simulation and test in real world. Demonstrate flow charts, calculation wheels, and other predictive models. Ask class to bring in list for next time.		

SIMULATION AND EVALUATION
UNIT K
SECTION II

PROCESS GUIDES: SIMULATE-TEST, SYNTHESIZE-RANDOMIZE, MINIMIZE-MAXIMIZE, INCREASE-DECREASE EXAGGERATE-UNDERSTATE

EVENTS AND DESCRIPTION	CONTEXT	REFERENCES
Common Experience - Simulation of Reality Begin with films of various kinds of simulations. Try to include most of basic types of simulations and try to compare predictions with actual developments, where possible. Ask class to relate basic heuristic operations to film discussion of simulation design.	Film Space flight simulations. Disneyland films, Movie making films, fluid dynamic simulations.	
Discussion - Systematic Vs. Random Ask for examples of basic types of models and of various kinds of heuristic uses. Ask for additional examples prepared as homework. Discuss the use of systematic and random methods of generating and evaluating: morphological approach, what are all the possible ways of doing something. Demonstrate how random trials, if made in great quantities, can give reliable results. Refer to insurance companies and polls.		Life Insurance companies.
Common Experience - Trying It Out Ask students to take any of previous games or puzzles and to figure out random and systematic approaches to solving them.	Games Any of the previous ones.	
Discussion - Trade Offs Review basics of simulation design, especially game design. Emphasize necessity of trade offs between complexity and accuracy. Discuss usefulness of games as simulations of real life as used so far in classroom.		
Common Experience - Designing a Game Brainstorm useful games to be designed. What games should be developed to help students. Choose a few and divide up in groups to try to design a game. Have different groups test others' games.	Problem Design of games of choice.	
Discussion - How Did You Do? Discuss game design problem. Make preparations for Problem Day.		

SIMULATION AND EVALUATION
UNIT K
SECTION III PROBLEM DAY

PROCESS GUIDES: SIMULATE-TEST, SYNTHESIZE-RANDOMIZE
MINIMIZE-MAXIMIZE, INCREASE-DECREASE
EXAGGERATE-UNDERSTATE

EVENTS AND DESCRIPTION	CONTEST	REFERENCES
Discussion Problem of class choice. Perhaps the simulation and testing of some design solution of an earlier problem.	Problem	

APPENDIX III

FILMS, GAMES, AND PROBLEMS

The following lists of films and games are available from commercial outlets in the San Francisco Bay Area. These lists illustrate that the kinds of teaching materials we specify are available. As much as possible, we intend to use films and games from school libraries and other free sources. We also include a list of problems we use in the course.

FILMS

FILM TITLE AND DESCRIPTION	UNIT	MINUTES	PRICE
A is for Architecture Changing concepts in architecture, buildings.	F	30	$ 18.50
Architecture West Evolution of architectural design.	F	20	11.00
Automatic Machines Automation in schools, industry, science.	J	25	8.00
Band on the March Marching band training.	C	10	5.00
Basic Training of Foil Fencing	C	22	9.00
Blinkety Blank Laws of persistence and after-image.	E	6	5.00
Boogie Doodle Experimental film with music and color.	G	4	4.00
Cartoon Parade Disney films	K	25	10.00
Challenge to Mankind Threat of over-population.	I	28	8.00

FILM TITLE AND DESCRIPTION	UNIT	MINUTES	PRICE
Charts Technical charts in use. College level only.	F	18	$ 6.00
Chick Embryo Time lapse of chick forming and hatching.	F	12	8.00
Cities of the Future	A	*	*
Computer Animation Example	F	*	*
Computing for Fun	F	*	*
Computer Generated Ballet	J	3	*
Control Revolution Computers and machines in business.	J	29	8.00
Cross Country Runner Example of fixation.	I	14	4.50
Dance Squared Experimental film with color, motion, and geometrics.	E	4	4.00
Designing a Set Conferences and sketches leading to stage set designs.	I	11	7.00
Design Into Space Sketch - simulation - product of space design.	K	10	7.00
Discovery of Inert Gases	H	18	13.50
Dots Experiment in color and sound.	G	3	4.00
Drawings and the Shop Relation between drawings and production operations.	F	15	5.00
Dream of Wild Horses	G	9	10.00
Dr. Leaky and the Dawn of Man Search into man's ancestry.	J	30	8.00
Erosion - Leveling the Land	F	14	8.50

* Information not available from catalogues.

FILM TITLE AND DESCRIPTION	UNIT	MINUTES	PRICE
Evolution of the Motion Picture	K	23	4.00
Eye of the Beholder Events in an artist's day as seen by him and five others.	E	27	13.00
Fidelity of Report Observe robbery/ stop film/ list data/ start film and check data.	E	10	4.00
Flow Process Chart and How to Use It	F	*	*
Fluid Dynamics of Drag Simulating the dynamics of drag.	K	21	7.00
Help! My Snowman's Burning Down Experiment in the Absurd.	G	10	10.00
Human Brain Function of the brain; perception, analysis, etc.	E,H	10	4.00
Industries of the Future	A	*	*
Jackson Pollack Paintings and technique.	F,G	10	7.50
Jonas Salk - Science of Life	H	*	*
Learning is Searching Research as learning experience.	J	30	8.00
Leonardo Da Vinci Sketches, works.	E,G	25	8.00
Living in Space	K	*	*
Logic by Machine Computer use vs. man's mind.	H	29	8.00
Man and the Moon Simulated trip around the moon.	K	20	10.00
Man in Space	B,K	*	*
Marc Chagall	G	26	15.00

* Information not available from catalogues.

FILM TITLE AND DESCRIPTION	UNIT	MINUTES	PRICE
Mary's Day Posters and sounds of the pop world.	F	14	$ 11.00
Moonbird Children's Fantasy.	G	10	7.50
Nine Variations of a Dance Theme	B,G	13	7.50
Origins of the Motion Picture Evolution of motion pictures from Leonardo da Vinci to Edison.	K	21	6.00
Paper in the Round Manipulation of paper in many ways.	B	11	6.00
People by the Billions Population explosion.	J	28	8.00
Perception Patterns of response, illusions, visual space perception.	E	25	5.00
Plant Growth Time-lapse film of a plant growing.	F	10	4.00
Pond and the City Our dwindling resources and the need for conservation.	I	16	15.00
Problem Method Part I Defining a problem and gathering information.	J	18	6.00
Programming in Fortran IV Introduction to computers.	F	30	10.00
Report on Smog	I	27	*
Roadrunner Cartoon	B	*	*
Salesmanship I Training film.	C	*	*
Scientific Method Scientific Problem-solving.	H	12	4.00
Seven Bridges to Koenigsberg Crossing the seven bridges in single continuous walk.	H	4	4.50

* Information not available from catalogues.

FILM TITLE AND DESCRIPTION	UNIT	MINUTES	PRICE
Shape of Things to Come	A	21	*
Shop Procedures Mechanical drawings related to each step in manufacturing.	F	17	6.00
Signs of Life Road sign, direction signs.	F	10	4.00
Story of Antburg U.S.A.	I	8	4.00
The Dot and the Line Color and graphics.	G	*	*
The Man Who Invented Gold Discovery film.	H	14	10.00
The Population Explosion	I	*	*
The Saga of Windwagon Smith	K	13	8.00
"Thinking" Machines	B,J	20	10.00
Time Lapse Studies of Growing Trees	F	10	6.00
Town Planning	I	15	6.00
Two Men and a Wardrobe	G	15	15.00
Two Paradoxes	I,H	2	*
Very Nice, Very Nice Satire on inconsistencies and chaos of world.	J	8	6.00
Volley Ball for Boys Training film.	C	10	4.00
Water Water problems throughout world.	I	14	8.00
Water Friend or Enemy.	I	10	*
Yellow Jack Discovery and proof of mosquito as yellow fever carrier.	H	29	8.00

* Information not available from catalogues.

FILM RENTAL AGENCIES IN THE SAN FRANCISCO BAY AREA

Audio Film Center
406 Clement Street
San Francisco

California State Department of Public Health
2151 Berkeley Way
Berkeley

Canadian Film Library
44 Montgomery
San Francisco

Contemporary Films
1714 Stockton
San Francisco

Ideal Pictures, Incorporated
1840 Alcatraz Avenue
Berkeley

Pacific Telephone Film Library
16 Spear Street
San Francisco

Photo Sound Company
116 Natoma Street
San Francisco

Western Cinema Guild, Incorporated
381 Bush Street
San Francisco

GAMES

GAME	GAME TYPE	UNIT	MANUFACTURER	PRICE
Bali Buttons	Arrangement Puzzle	F,K	Behavioral Sciences, Inc. Palo Alto, California	$ 1.00
Barrel of Monkeys	Balance game	B	Lakeside Industries, Inc. Minneapolis, Minnesota	1.25
Bicycle Playing Cards	Card games	All	U.S. Playing Card Co.	.79
Checkers	Strategy	All	Steven Manufacturing Co. Herman, Missouri	2.50
Chess	Strategy	All	Gallant Knight, Inc. Northbrook, Illinois	3.95
Clue	Detective	H,J	Parker Brothers, Inc. Salem, Massachusetts	6.00
Construct-O-Straws	Modular Building	D,F	Parker Brothers, Inc. Salem, Massachusetts	2.50
Crossword Blocks	Word Puzzle	J	Creative Playthings Los Angeles, California	3.00
Etch-a-Sketch	Manipulation	G,F	Ohio Art Co. Byran, Ohio	4.00
Far Eastern Checkers	Strategy	All	Crestline Manufacturing Co. Santa Ana, California	6.95
Fascinating Cube	Arrangement Puzzle	F,K	Skor-Mor Corporation Anaheim, California	2.95
Frustration Ball	Manipulation	B	Remco Industries Harrison, New Jersey	3.10
The Game of Go	Strategy	All	Wm. F. Drueke & Sons, Inc. Grand Rapids, Michigan	5.00
Impuzzlebles	Arrangement Puzzle	F	Lakeside Industries, Inc.	1.00
Instant Insanity	Arrangement Puzzle	F,K	Parker Brothers, Inc.	1.00

GAME	GAME TYPE	UNIT	MANUFACTURER	PRICE
Krazy Legs	Arrangement	B	Raython, Incorporated Dallas, Texas	$10.00
Jigsaw Puzzles	Arrangement	F,J	Springbrook Editions New York, New York	3.50 ea.
Lego	Modular Building	F,G	Samsonite Corporation Denver, Colorado	.79 to 7.98
Magic Tricks	Interlocking Puzzles	H,F	Made in Japan	1.25
Marksman Darts	Skill	B,J	Marksman Products Los Angeles, California	2.98
Mental Blocks	Arrangement Puzzle	F	KMS Industries Ann Arbor, Michigan	2.00
Monopoly	Strategy	K	Parker Brothers	6.00
Nervous Breakdown	Mirror Skill	F,E	Kohner Brothers, Inc.	.79
Peg Puzzles Cross Over Pyramid Solitaire Square	Strategy	All	Crestline Manufacturing	3.00 e
Pick Up Sticks	Skill	B	Lakeside Industries, Inc.	1.00
Puzzle Games Hexed Hi-Q Krazy Quilt Pythagoras	Arrangement	F,H,K	Kohner Brothers, Inc.	1.00
Qubic	Strategy	I	Parker Brothers	3.00
R.S.V.P.	Strategy	J,B	Selchow & Righter Co. Bay Shore, New York	6.00
Ring Toss	Skill	B	Pressman	1.29
Scrabble	Word Game	J	Selchow & Righter Co.	5.00
Six in One	Strategy	All	Shoek Manufacturers New York, New York	2.00

GAME	GAME TYPE	UNIT	MANUFACTURER	PRICE
Skittles	Skill	B,J	Carron Company	$ 9.98
Sky High	Balance	B	Skor-Mor Corporation	2.95
Slinky	Manipulation	F	James Industries, Inc.	1.00
Spirograph	Manipulation Graphics	G	Kenner Products Co. Cincinnati, Ohio	4.50
Swiss Blocks	Balance Modular Building	B,F,G	Switzerland	7.95
Three Blind Mice	Skill and Balance	B,J	Lakeside Industries, Inc.	1.20
Three-D Tic Tac Toe	Strategy	I	Cadaco - Ellis Chicago, Illinois	3.50
Tiddledy Winks	Skill	B	Milton Bradley Springfield, Massachusetts	1.20
Tops	Skill and Manipulation	B,C	Swiss, German - Imported	.15 to 1.00
Trauma Tower	Skill Arrangement Puzzle	F	Skor-Mor Corporation	2.95
Trial and Balance	Skill	B	The Kingster Co. Torrance, California	4.98
Try-Omino	Strategy	All	Pressman	3.98
Wiff'n Proof	Strategy	All	Wiff'n Proof Publishers New Haven, Connecticut	
Wiff'n Proof	Logic			5.98
Wiff	Logic			1.25
On-Sets	Math			4.00
Tic Tackle	Strategy			1.00
Tri Nim	Strategy			4.00
Propaganda	Strategy			5.00

PROBLEMS

PROBLEM	TYPE OF PROBLEM	UNIT
Anagrams	Word, Letter Manipulation	B
Cannibals and Missionaries	Logic	I
Charades	Pantomine	K
Crossword Puzzle	Word Manipulation	J
Dancing Boxes	Word Manipulation	D
Factoring Equations	Math	F
Hangman	Word Guessing	H
Hidden Word Search	Word Searching	J
How Many...	Memory	E
In my Bag I Packed...	Memory	E
Inquiry Box	Arrangement Guessing	B
[illegible] and Son	Logic	I
Mixed Phrases	Word Manipulation	[illegible]
Mystery Problems	Logic	[illegible]
Simulation Games	Simulation	K
Sorting Games	Sorting	F
Spoon Puzzle	Manipulation	H
Submarine	Manipulation, Guessing	B,I
Teapot	Word Guessing	I
Ten Trees - Five Rows	Logic	J
Three Dots	Logic	I
Three Knives	Manipulation, Logic	H
Twenty Questions	Word	H
Two Containers	Logic	I,J
Two Trains	Logic	H
What Did You Do On the Day of...?	Memory	E

GAME BIBLIOGRAPHY

Barnard, D. St. P., A Book of Mathematical and Reasoning Problems, D. Van Nostrand Company, Incorporated, New York, New York, 1962.

Gardner, Martin. Martin Gardner's New Mathematical Diversions from Scientific American, Simon and Schuster, New York, New York, 1966.

Garroway, Dave, Fun on Wheels, McGraw-Hill Book Company, New York, 1960.

Harbin, E. O., Games of Many Nations, Abbington Press, New York, 1954.

Kaplan, Philip, Posers, Harper and Row, New York, 1963.

Kendall, P. M. H., and Thomas, G. M., Mathematical Puzzles for the Connoisseur, Thomas Y. Crowell Company, New York, 1962.

Kettlecamp, Larry, Puzzle Patterns, William Morrow and Company, Clifton, New Jersey, 1963.

Pashko, Stanley, The Book of Indoor Games, Greenberg Publishers, New York, 1947.

Thomsen, Robert, Games Anyone? Doubleday and Company, Incorporated, New York, 1964.

APPENDIX IV

GOALS OF INTERACTION, INC.

Interaction, Inc. was incorporated in Delaware, February, 1969, to research and develop problem-solving processes. We are interested in the interaction of men with men; and men with augmentation systems. We believe that problem-solving and the teaching of problem-solving processes should interact in an environment of openness and cooperation. There should be a middle ground between pure research and the realities of business practice: meeting places for men with problems and the multitude of organizations that deal with special aspects of problems. These places should be problem-solving centers: supporting environments equipped with augmentation technologies where men can come to take an initial look at their problems with people of many professional backgrounds. Today, all too often, we have to predefine our problems just to be able to talk with each other. Many of the potential solutions of problems as a whole are overlooked because we approach them from restricted points of view.

Interaction, Inc. plans to play three roles in the field of problem-solving: as a problem-solving, research, and educational organization. As a consultant firm, Interaction will serve as a clearing house for

problems, linking clients with independent men and organizations that are interested in coalescing around specific problems. Interaction will provide environmental and technological supports for a pre-programming phase in which the problem is approached as a whole. Interaction staff will facilitate the process of group problem-solving and interface technology and new processes whenever needed. In later stages of projects, Interaction can provide technological and advisory services, aiding in the coordination of group efforts among specialized organizations.

As a research organization, Interaction will provide a testing ground for the use of interactive systems in problem-solving, serving as a link between pure research and application oriented organizations. We believe in the boot-strapping approach to research and development that requires the internal use of all new processes and technological aids. This approach intensifies the feedback between idea and evaluation and employs any workable innovations to accelerate development.

As an educational organization, Interaction will offer training programs in new problem-solving processes and the use of augmentation systems. Interaction will also continue to develop courses in problem-solving designed for educational institutions, like Tools for Change, prepare materials and teacher guides, and offer teach training programs in the presentation of such courses.

APPENDIX V

BRIEF RESUMES

David A. Straus

Mr. Straus is the founder of Interaction, Inc. For the past year he has devoted most of his energies to researching problem-solving processes and interactive computer systems. He has made several trips around the country reviewing the state of the art in graphic hardware and software design. He has been acting as observer-consultant to companies in the field of interactive graphics (Augmented Human Intellect Research Center, Stanford Research Institute; Design Systems, Inc., Boston, Massachusetts; and Digital Equipment Corporation, Maynard, Massachusetts), to large architectural offices (Skidmore, Owings, and Merrill, San Francisco; Helmuth, Obada, and Kassabaum, St. Louis, Missouri; and Perry, Dean, and Stewart, Boston, Massachusetts), and to a problem-solving firm (Synectics, Inc.). From September 1968, to June 1969, Mr. Straus was Associate Director of a National Institute of Mental Health grant at the Department of Architecture, Berkeley, researching heuristics in the field of design methodology. His report, Problem-Solving Notebook, was accepted for thesis credit in the Bachelor of Architecture Program at the Harvard Graduate School of Design. Before entering the Department of Architecture at Harvard in 1963, Mr. Straus spent a year as a special student at the Architectural Association and the Central School of Art in London. In 1964, he received his AB, Cum Laude, from Harvard in Physical Sciences. Born on September 29, 1942, Mr. Straus was raised in Manhattan.

R. Christopher Thorsen

In the past two years Mr. Thorsen has worked in over fifty Bay Area schools from kindergarten through the graduate level. His classes and workshops for administrators, teachers, and students centered on fantasy brainstorming, creative writing, and readings of his own haiku poetry, (Gnarled Grasses, Rau Painu Press, Mill Valley, California, 1968). Other organizations having used his services include the National Council of Teachers of English, KQED TV, Youth Drug Unit, Langley Porter Neuropsychological Research Institute, Catholic Social Services, and Forest Farms Summer Camp. Mr. Thorsen is also involved in Marin County drug abuse education, sitting on the committee dealing with that problem and leading youth discussion groups within the program itself. Born in 1943, he was brought up in the farm country of Illinois before moving to California in 1964.

Ruth E. Thorsen

In addition to working with her husband last spring, Mrs. Thorsen has taught in the Shasta School (an experimental high school in Marin County, California), Marin Country Day School, Marin County (experimental summer program), and Ding Dong Day Nursery School in Illinois. She has also worked with Forest Farms Summer Camp and the pre-schoolers of the Mill Valley Recreation Department in Marin County. Her particular interest in education is experimental learning at the pre-school and elementary levels. Mrs. Thorsen is now working toward a Masters in Education having received her B.A. from the University of Denver. Born in 1943 and raised in the Fox River Valley of Illinois, she has lived in California since 1966.

APPENDIX VI

RESOURCE PEOPLE

These people are personal friends to whom we can turn for advice. It must be made clear that they are under no obligation at this time.

Audio Visual Consultants

Donald Freeman
Cambridge Design Group
12 Arrow Street
Cambridge, Massachusetts

Robert N. Johnson
Author and Film Teacher
Drake High School
San Anselmo, California

Augmentation Systems Consultants

Dr. Douglas C. Engelbart
Manager, Augmented Human Intellect
Research Center
Stanford Research Institute
Menlo Park, California

Thomas Follett
Design Systems, Inc.
Boston, Massachusetts

Education Consultants

Carter C. Hanner
Professor of Psychology
Marin Junior College
Kentfield, California

Albert L. Lavin
Author and Editor
Supervisor of English
Tam Union High School District
Larkspur, California

Education Consultants (continued)

Dr. Robert McKim
Department of Design
Stanford University
Palo Alto, California

Gerald O'Donnell
Assistant Superintendent
Department of Education
Diocese of Oakland
Oakland, California

Dr. Robert Olton
Center for Productive Thinking
Department of Psychology
University of California
Berkeley, California

Richard L. Riseling
Director of International Affairs
American Baptist Convention
777 U.N. Plaza
New York, N.Y.

Robert Swain
Director, High Potential Program
Berkeley School System
Berkeley, California

Gordon Tappan
Executive Treasurer
American Association of Humanistic
Psychology
Professor of Psychology
Sonoma State College
Rohnert Park, California

Education Consultants (continued)

Jim Van der Ryn
Assistant Professor
Department of Architecture
University of California
Berkeley, California

Joyce Wilson
Director, Most Able Learner Program
Reed Union School District
Tiberon, California

Game Consultants

Barry P. Barnes
Far West Laboratories
Claremont Hotel
Berkeley, California

Dr. Eli Bower
Department of Education
University of California
Berkeley, California

Patrick Cudmore
Abt Associates
55 Wheeler Street
Cambridge, Massachusetts

Heuristic Programming Consultants

Charles M. Eastman
School of Urban and Public Affairs
Carnegie-Mellon University
Pittsburg, Pennsylvania

Carl Helm
Director of Computer Assisted Instruction
City College of New York
33 West 42nd Street
New York, New York

Legal and Business Consultants

Robert Cassel
Attorney and Grants Management
Consultant
3653 Scott Street
San Francisco, California 94123

Joseph J. Iseman
Paul, Weiss, Goldberg, Rifkind,
Wharton, and Garrison
575 Madison Avenue
New York, N.Y. 10022

John C. Pepper
Room 1740
420 Lexington Ave.
New York, N.Y.

Special Consultants

Jordan Fishersmith - age 14
Mill Valley, California

Peter Freeman - age 12
Cambridge, Massachusetts

Mark Thorsen - age 13
Batavia, Illinois